EDITORIAL

THE ancient Phoenicians christened a ship by breaking an egg upon the deck. What happened if the egg was a little old is not stated.

FAITHFUL retainers of the ex-Kaiser, who have expressed a wish to be tried in his place have been rebuffed. The Council of Five has announced definitely that when the final box-score is issued, it will not be recorded that Von Bethmann-Hollweg, or any other substitute, batted for W. Hohenzollern in the ninth. The ex-Kaiser started the trouble and he will have to finish it.

THE first steel merchant-vessel to be built in the State of Victoria, the 'Dromana', was recently launched at the Government yards near Melbourne. This is one of 20 vessels of the Isherwood type that the Australian government has undertaken to build. The equipment and all the structural material except the plates were manufactured in Australia. The cost of the vessel is reported to be $136 per ton.

IF you have any idea that the peace terms are too hard on Germany, look at the illustrations on page 344 of this issue. These views were taken by Mr. Frank H. Probert, Professor of Mining at the University of California, while on an official mission estimating the damage in the occupied regions. They are a fair sample of what was done to industrial plants generally in the occupied regions, usually without the slightest excuse on the grounds of military necessity.

PRICES of ships reported at Lloyd's as having been sold during the first three months of the year have recently been made public. Lack of details regarding the condition or equipment of the vessels makes comparison difficult. However, a 'standard steamer' built last year, and with a deadweight tonnage of 10,800 sold, at the present rate of exchange, for $188 per ton. On the other hand, another 'standard steamer', also built last year, of 8130 tons sold for $96 per ton. Other 'standard steamers' ranging from 3000 to 5000 tons, sold around $150 per ton.

AMONG the laws enacted at the recent session of the California legislature and now in effect are two of considerable importance to industry, in view of the Smith-Hughes act and other phases of the movement for more effective vocational education. These laws compel the attendance at school for at least four hours each week of all persons between the ages of 14 and 18, and also the attendance at night schools of persons between the ages of 18 and 21 who cannot speak, read, or write the English language to a degree of proficiency equal to that required for completion of the sixth grade.

THE industrial situation in the United States was aptly characterized by Mr. Philip N. Moore, Past President of the American Institute of Mining and Metallurgical Engineers, in an informal address during his recent visit to San Francisco. In effect he said that the industrial and political situation used to be controlled by American business, which was "mainly brains, very little heart, and no guts at all." American labor "with very little brains, a great deal of heart, and plenty of guts," had, however, come along, and was now in a dominating position. The moral is—but no, let the reader draw his own moral.

AN arbitration board really arbitrating, and that quickly, in a labor dispute is one of the wonders to which the North-West has recently been treated. The grain-handlers and dock-operators of the Columbia River and Puget Sound ports struck for higher wages. On July 18 the arbitrators were asked to serve; on July 23 a hearing was held; and on July 24 the award was made. Other interesting features of the dispute included the fact that the men went back to work pending the award, and also that the wage established is the same for all the ports affected, thus placing them on an equal footing as far as labor costs at the terminal are concerned. Some of the Federal wage boards exhibited a slowness in rendering a decision similar to that which has been a reproach to many of our courts. This same slowness, besides being exasperating to both sides, furnished an excuse for the retro-active awards that are such a bane to the employer, making it impossible for him to estimate labor costs in advance.

DIESEL and semi-Diesel engined ships have become so common that a map recently published in 'Sinclair's Magazine' showing oil and coaling stations in all parts of the world is of special interest. North America is well supplied with oil stations to fit the needs of even the ship with a small cruising radius. After leaving the ports on each side of the Panama Canal, there are no oil stations shown on the mainland of South America, although Curacao and Trinidad, both just off the northern coast, may properly be counted as South American ports. Oil-stations under construction are noted at Rio de Janeiro and Buenos Aires. Europe has oil-stations at London, Rotterdam, and Lisbon. There are three oil-stations in Africa near the Suez Canal, at Alexandria, Port Said, and Suez, and one at the other end of the

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continent at Cape Town. The Asian coast from Karachi, India, to Nagasaki has oil-stations at frequent intervals, and there are several in Malaysia and Australia. Altogether, the question of fuel-supply need not deter a shipowner from building oil-engined vessels.

Federal Employment Service

Mr. John B. Densmore, Director of the United States Employment Service, is in trouble again. Congress is inquiring anxiously how much of Uncle Sam's good money went for that Mooney report. An unconfirmed report quoted Mr. Densmore as denying any part in the report that has, since last November, been coupled with his name. Later, Secretary Wilson has authorized a statement that the report cost the Government nothing, since all those engaged in the work were already on the Federal payroll. It is possible that the work for which these men were nominally paid was of so little value that they were not missed, but did they beg, borrow, or steal the dictaphone and wires? The only remaining hypothesis is that the entire report is the product of whole cloth and an imaginative brain, in which case it may have cost nothing. The worst feature about the whole affair is that it and other activities of doubtful value have thrown discredit upon the Employment Service, which has done some good work, and which might develop into a useful institution. The present intention of Congress seems to be to reduce the appropriation available to such a point that it will be impossible to do more than maintain a central bureau co-ordinating the activities of the various State, municipal, and other public employment offices. This is the best field of activity for a Federal bureau anyway.

The Still Engine

A new type of heat-engine, which seems to have passed the experimental stage, has recently been developed in England by W. J. Still and F. E. D. Acland. The Still-Acland engine, or, as it is more commonly called, the Still engine, takes advantage of the fact that one of the principal problems of steam-engine design and operation is to keep the walls of the cylinder hot, while the corresponding problem with internal-combustion engines is to keep the cylinder-walls cool. Disregarding technical details, the engine might be described as primarily an internal-combustion engine in which the cooling-water is used to generate steam. To accomplish this, the jacket and cooling-water form part of the circulating system of a steam-generator. The cooling-water enters and leaves the jacket at a constant temperature, regulated by the pressure of the steam. Cooling the jacket is effected by converting the water into steam without adding heat. A thermal efficiency of approximately 40%, the loads ranging from one-quarter to full load, has been obtained, thus showing considerable improvement over even Diesel engine efficiencies. Using shale-oil for fuel, a consumption of only 0.302 pounds per brake-horsepower hour was recorded.

Relation of Hours to Output

A report on 'Hours of Work as Related to Output and Health of Workers in the Metal Manufacturing Industries' has recently been issued by the National Industrial Conference Board. The conclusions of the report have a somewhat academic interest on the Pacific Coast, since they deal with the advisability of reducing hours of labor to 48 or 50 hours per week. Questionnaires were sent in both 1917 and 1919. Replies were received from 1246 establishments employing 750,709 workers. Of the establishments replying, 93% were open-shop. Reductions in hours to either 48 or 50 per week were reported by 405 establishments employing 355,484 workers. The report states that it is possible for "a considerable proportion of establishments to maintain production on a schedule of 50 hours per week," but that such a schedule "could not be universally adopted by these industries without some loss in production." Regarding the 48-hour week, the report states that reductions to such a week proved satisfactory from a production standpoint" in a sufficient number of cases to invest such a schedule with a high degree of interest," but that "the weight of evidence leaves little ground for doubt that a general reduction to a 48-hour week at the present time would mean a serious loss in production." Regarding health of workers, the report states that conclusions as to the effect of reductions in hours of work on health of workers cannot be reached at this time, because data covering a sufficient period to permit satisfactory study are not in existence. Such investigations are also handicapped by the absence of any recognized standard for measuring health conditions. While recognizing that the effect on social conditions must also be considered in any complete discussion of the hours-of-work problem, the report holds that such social conditions can best be studied in the light of reliable information regarding the effect of hours of work upon health and output, and that, therefore, discussion of the effect on social conditions should be postponed until such information has been compiled.

'Boosting' the Union Scale

Among the evils that have tended to throw discredit upon collective bargaining, and, with some observers, to obscure its good points, is the practice of forcing up the actual wage-scale for a given class of work above the amount determined by agreement between the unions and the employers. The process about to be described must not be confused with piece-rates or bonuses for increased production or with the payment of a higher day-rate to a man that because of long service or special skill is worth more than the average. There

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are variations in the 'boosting' game, but the general plan is somewhat as follows: Let us suppose that the union rate for a certain class of work is $6 per day. Smith is a worker in Jones' shop, and Jones, with his shop already pretty well filled, receives an order that can be gotten out best on Smith's machine and with Smith's particular shop experience. Smith goes to Jones with a demand for a raise to $6.50 per day, giving some excuse or none at all, and saying that he will quit if he does not get it. Thinking only of a temporary need of keeping the work moving, Jones surrenders. Pretty soon all the men on that class of work in Jones' shop have demanded and obtained a similar raise. The scene now shifts to Brown's shop, where the old $6 rate is still in force. It is a simple matter to bring Brown to time by threatening to go and work for Jones. Robinson's shop soon swings into line, and before long practically every shop in town is paying the $6.50 rate, and all without any open fuss at all. Everything is now ready for forcing a $7 scale, using a similar process. Soon after the $7 rate has become general, a conference is called to consider a new agreement in place of the old one, now about to expire. As most of the men are actually getting $7 per day, it may be accepted as certain that the new agreement will provide for at least that amount in place of the old $6 rate. Indeed the employers may consider themselves fortunate if a $7.50 scale is not established. We do not believe that this method of forcing wage increases has ever been encouraged by the really responsible labor leaders, but they must have known it was going on, and they have done little or nothing to discourage it. From the employer's standpoint, the principal advantage of collective bargaining is that, by establishing a fixed wage-scale, it helps him to figure labor costs. If, in reality, no such fixed scale is established, there is little reason for entering into such a bargain. However, employers who, for a slight temporary gain, sacrifice their own interests and the good of the industry in the manner just described, are principally to blame for the evils that follow. Either the employers or the labor leaders, working alone, could stamp out this practice of irregular wage increases. Co-operation, however, between the two interests would render the job much easier and simpler.

Foreign Competition

During the War, a frequent cry of those who could not find anything else to worry about (in spite of the fact that there were plenty of better reasons for anxiety) was the danger of foreign competition after the War was over. We were told that manufacturing plants in European countries had attained almost incredible efficiency, and that soon after hostilities ceased we would find all our foreign and much of our domestic market captured by a flood of cheaply produced goods. Nearly nine months have passed since the armistice was signed, and what are the conditions we meet? France and Belgium, as was to be expected, are too much occupied with the actual work of 'reconstitution' to think of anything else. Italy's industrial development might be said almost to date from the War, but there seems to be little immediate likelihood of her reaching out for foreign trade, or even of supplying her home market. It is too soon to speak definitely of Germany, but loss of much of her former coal and iron, internal disorders, surrender of ships, and other difficulties are not going to make for efficient production and marketing. England was the country which we were told had experienced an industrial revolution, with the elimination of all the old limitations on output. Yet American steel-makers have secured several large orders for rails and other steel products, including tinplate, from English consumers, being able to quote lower prices and earlier deliveries than their British competitors. Neither does the naming of these lower prices require any application of the higher mathematics. All that is required is to add the freight, still very high, to the American base price, and the thing is done. While wages in England have increased tremendously during the past five years, they are not yet as high as American wages, but actual labor costs are evidently higher. Even in shipbuilding there seems to be good reason for the belief that American yards can compete with British ones. The Scandinavian countries, being neutral, experienced a minimum of disturbance of their industrial systems, and might be expected to be more ready to resume business on a peace basis than any of the belligerents. Yet a Portland firm has just received a contract for four 6000-ton steel ships from a Scandinavian syndicate. While unsatisfactory industrial conditions in Europe awaken feelings of regret and sympathy from American manufacturers, they should, however, be a source of encouragement for expansion of business activities without fear of ruinous competition from across the Atlantic.

Wages and Prices

While most of the declarations adopted by the American Federation of Labor at its recent convention at Atlantic City gave evidence of a spirit of sane conservatism, other points of the program are not so commendable. We shall not take the time to discuss the advocacy of a defiance of injunctions. Any man may honestly doubt the justice of individual legal decisions, but it is useless to argue, except by means of a club, with anyone proposing a general defiance of the courts, whether of law or of equity. Other parts of the program, however, are really more objectionable, because, while they sound rather nice at first, they are found, upon analysis, to be opposed to fundamental economic laws. We refer, in particular, to the advocacy of an indiscriminate reduction in hours of labor and of a readjustment of wages so that "earnings of labor will buy the same amount of the necessaries of life that could be purchased by these earnings previous to the War." Let it be admitted that, while wages in certain industries have increased faster than the cost of

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living, taking labor as a whole, it is probable they have lagged behind prices. Nevertheless, in the aggregate, labor earns and pays its own wages. Nobody else pays them, because nobody else can. Out of what labor, with the assistance of capital and management, produces, labor takes its own return. The more labor produces, the more it can take. The less labor produces, the less it can take. The principal factors in the high cost of living are high wages and, in some cases, low production during working-hours. These conditions may be beneficial, but let us not fool ourselves into thinking we can reduce the actual cost of living by increasing wages. The only logical way is by increasing production and reducing waste. This may be by improved methods of manufacture and distribution; it may be by increasing hours; it may be by decreasing hours; it may be by the abolition of limitation of output; it may be by several of these methods, but pulling on our own boot-straps will never get us out of the mud.

Threatened Steel Strike

A vote is now being taken in the unions throughout the iron and steel districts on the question of calling a strike, which would have for its main object the unionizing of the iron and steel industry. Some of the other demands announced are as follows: Increase in wages sufficient to guarantee American standards of living. Standard scales of wages in all trades and for all classes of workers. Principles of seniority to apply in the maintenance, reduction, and increase of working forces. Abolition of physical examination of applicants for employment. Abolition of company unions. This last pronouncement reflects the hostility of many labor leaders to the various plans for 'industrial democracy' now being tried in many plants. Employers in the steel industry are inclined to doubt the strike being called, or its success in case it is called. They point out that the average steel-worker is one of the few persons whose compensation has increased since 1915 faster than the cost of living, the average increase of wages during that period being 140%. Furthermore, only a relatively small proportion of the workers in the steel industry are affiliated with any union. The Amalgamated Association of Iron, Steel and Tin Workers is the largest single body. Reliable statistics as to its present membership are not at hand, but during the strike of 1902 the total number was about 12,000, and it is not believed that there has been any large increase. It was the Amalgamated association that recently asked Judge E. H. Gary of the United States Steel Corporation to define the corporation's position on union recognition, to which he replied that the corporation still held to the open shop. While it was this reply that furnished the definite basis for the strike action, the plan is to call a strike in the plants of the independent companies as well as those of the Steel corporation.

The Shipyard Labor Conference

The conference between the representatives of the Pacific Coast shipyards and the shipyard employees, which began in San Francisco Monday, July 21, adjourned on Friday of the same week to Monday, August 4, without any definite action being taken. The labor representatives issued a statement to the effect that any agreement ratified must be coast-wide, covering all four districts. The agreement presented to the employers calls for an increase of 20 cents per hour over the present Macy scale and for a drastic closed union-shop condition. A Board of Adjustment is to be provided, which would consider any dispute between employers and any local metal trades council. Employers and employees would each be represented by five members and a secretary.

Los Angeles and Portland shipyards previous to and during the War, have been run on an open-shop basis. These districts never have dealt through collective-bargaining agreements and it is probable that they will be unwilling to consider any agreement that calls for the closed-shop. It is not known at the time of going to press whether or not Los Angeles and Portland will be represented at the conference when it is resumed on August 4.

R. W. Leatherbee, of Philadelphia, special representative of the Emergency Fleet Corporation, presented a statement on behalf of the Corporation to the effect that the employers would have to stand any raise given the men above the Macy scale. The Corporation will maintain the Macy scale until October 1, but will not reimburse the employers for any increase over that scale.

This conference between the Pacific Coast shipyards and the employees was called at the request of James O'Connell, president of the metal trades department of the American Federation of Labor. The first week's meetings were attended by representatives from each shipyard, representatives from the International union affected by an agreement, and six representatives of the Pacific Coast District Council of shipyard employees. It is expected that the further meetings will be between six shipyard representatives and the six representatives of the Pacific Coast council. The shipyards will be represented by A. S. Gunn, Bethlehem Shipbuilding Corporation, San Francisco, George Armes, Moore Shipbuilding Company, Oakland, L. J. Titus, Skinner & Eddy, Seattle, C. W. Wiley, Todd Drydock Company, Tacoma, C. H. Hamilton, Northwest Shipbuilders Association, and one other. The representatives of the Pacific Coast council are Thomas Russell, Tacoma, J. A. Taylor, Seattle, H. L. Sweeney, Oakland, R. W. Burton, San Francisco. In case Los Angeles and Portland do not participate in the further conferences C. S. Grow, of Los Angeles, and I. R. Concoff, of Portland, will be replaced by James O'Connell of the American Federation of Labor, and L. Weyand, International vice-president of the Brotherhood of Boilermakers, Iron Shipbuilders and Helpers of America.

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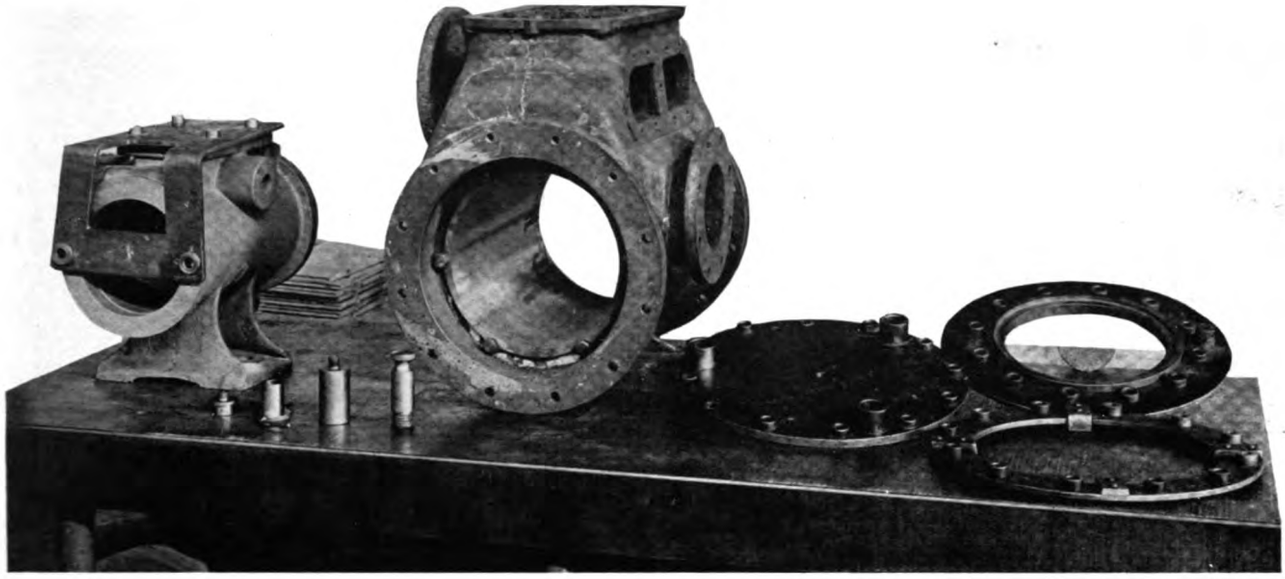
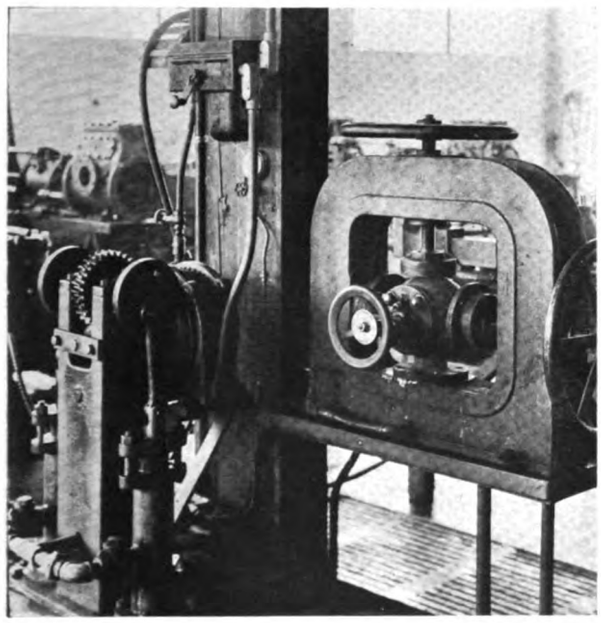


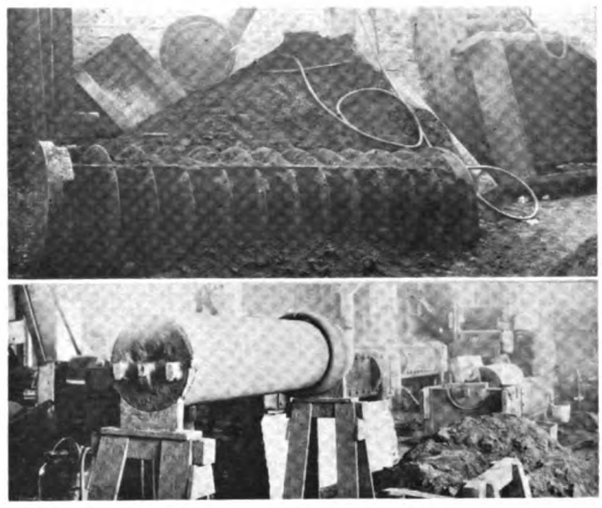
COMPLETED CYLINDER AND TOOLS AND JIGS USED IN ITS MANUFACTURE

Manufacture of Machinery at Plant of C. F. Braun & Company

ONE of the best equipped, well arranged, and most systematically organized metal-working plants in the San Francisco Bay district is that of C. F. Braun & Co., manufacturing mechanical engineers. This company is engaged in manufacturing pumps, both reciprocating and centrifugal, heat-exchangers, including condensers, feed-water heaters, oil coolers and heaters, cooling-towers, evaporators, as well as smaller specialties, such as valves and expansion joints. The plant is in the centre of the industrial district of San Francisco, fronting on Folsom, Alice, and Shipley streets. It may be said to have been progressively constructed. The machine-shop and assembling department were completed about two years ago, while the foundry and the pattern-shop were finished only recently. A building to



VALVE-TESTING APPARATUS. PRESSURE IS APPLIED BY PUMP AT LEFT



LARGE CORE, NOTE WATER-JACKET. THE METAL ARBOR IS SHOWN ABOVE

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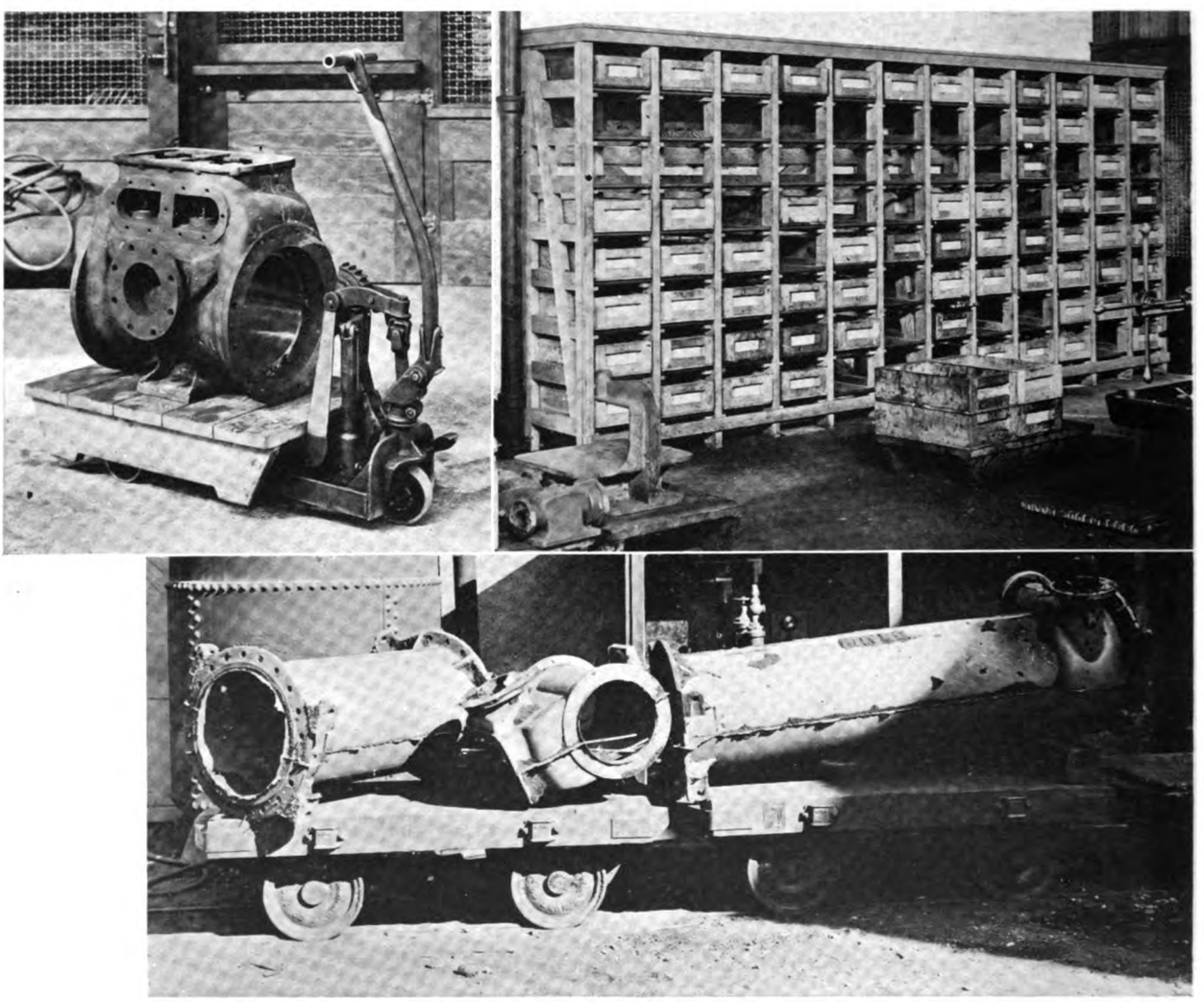
INTERIOR OF STOCK-ROOM

house the company's main offices, now in the Cunard building at 503 Market street, is to be constructed in the near future.

The pattern-shop, which is in one wing of the foundry, is equipped with all necessary planers, joiners, band-saws, circular saws, and sanding-machines. The machines are so arranged as to permit an increase in present facilities. Individual-motor drive is used throughout, of either the direct or belt-connected types.

Since nearly all patterns used are on repetition work, special care is taken with both material and workmanship. Except for certain relatively unimportant parts of the large patterns, mahogany is used almost exclusively. On page 341 is shown a condenser-head pattern, which is a good illustration of the method employed in building up laminated patterns.

The foundry is equipped with a 54-in. cupola. As the apparatus manufactured by the company requires the use of numerous complicated cores, great care has been used in the layout and construction of core-handling devices and ovens. Metal arbors of various shapes and



ABOVE, PLATFORM ON LIFT-TRUCK, ALSO 'TOTE-BOXES' AND RACK. BELOW, INDUSTRIAL RAILROAD.

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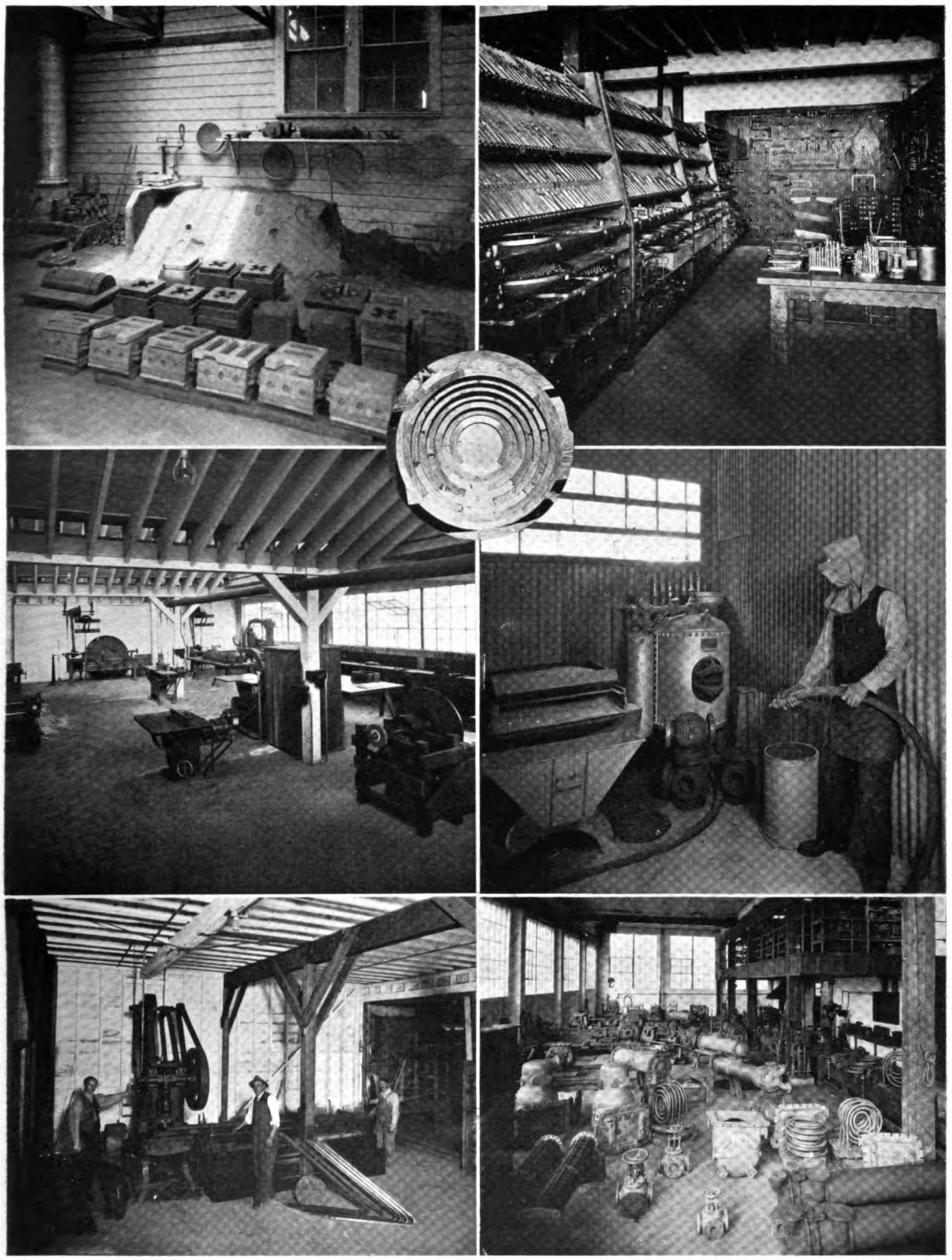

ABOVE, BRASS FOUNDRY AND TOOL-AND-JIG ROOM. MIDDLE, PATTERN-SHOP AND SAND-BLAST ROOM. BELOW, STEEL CUTTING ROOM AND ASSEMBLING SHOP. INSERT, LAMINATED PATTERN FOR CONDENSER-HEAD

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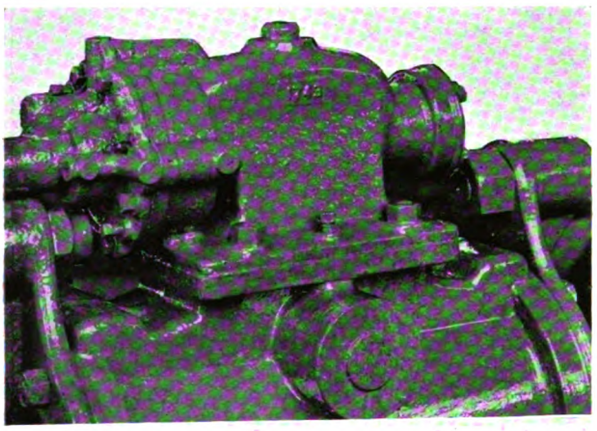
CHIPPING DEPARTMENT

sizes are used extensively as a backbone to these cores, as a considerable saving in time has been obtained by the adoption of this system as compared with other methods. Since a large proportion of the castings of certain types do not require machining, a particularly smooth surface is required on both the core and the surface of the mold. All sand is therefore machine-



ABOVE, THE COMPLETED PUMP CYLINDER. BELOW, TOOLS AND JIGS

mixed. Molding-machines are used wherever found expedient. Provision is made for handling the larger castings and cores, which weigh as much as five or six tons, by the installation of a 10-ton traveling crane. This crane was built from the company's own designs in its machine-shop, largely because at the time the foundry was under construction deliveries from crane manufacturers were much delayed.

present housed in a temporary building. However, plans are now under way for the erection of a permanent structure with increased and improved facilities. As a large variety of brass parts is required in the apparatus made by the company, this department is considered one of the most important. The sand-blast room, which is equipped with a complete Pangborn outfit, chipping-room, and oxy-acetylene welding and cutting room adjoin the main foundry building. The sand-blast outfit together with a large part of the other foundry equipment was furnished by Ditty Bros., of San Francisco.

The brass-foundry is at

Adjacent to the foundry is the main machine-shop so placed as to be readily accessible to the store-room, tool and jig-room, and the general erecting shop. The main equipment of this department consists of the following tools: One 36-in. Cleveland open-side planer; one 44-in., one 16-in., and two 20-in. American engine-lathes; one 18-in. Axelson engine-lathe; one Warner & Swasey turret-lathe; one 16-in. Smith & Mills shaper; one 36-in. Bickford radial drill; one 36-in. American radial drill; one 25-in. Weigle sliding-head drill, and Greenerd arbor-press; together with numerous grinders and small tools.

Probably the most important department in the plant is the tool-room where all jigs and tools are made up, racked, and catalogued. A few of these are shown on pages 339 and 342.

West of the main machine-shop is the assembling department, where provision is made for the handling of all finished or partly assembled machinery.

The layout of all parts of the plant is arranged to provide for the economical handling of all material, which moves in straight lines, wherever possible, from one end of a department to the other. With the exception of large castings and unit assemblies, no material is left on the floor of either the machine or the assembling shop. Bolts, nuts, valve-seats, and similar small materials are handled in 'tote-boxes,' which are of such size that they can be carried by one man. Page 340 shows a few of these boxes, also the 'tote-box rack'. When a machinist is assigned a work order on small articles, the materials are placed in 'tote-boxes' near his tool. A clock-card is then issued giving all the necessary data and instructions pertaining to the work. Larger material is carried on small platforms, which are placed close to each machine and which are transported from place to place on lift-trucks, as shown on page 340. Above each of the principal machines is a jib-crane, which is used for handling material from the platform into position on the machine. A 10-ton traveling crane serves the entire shop.

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MACHINE-SHOP

In order to facilitate the handling of materials between the shops, an industrial railroad has been installed with rolling stock of the type shown on page 340. Cars are readily operated by hand.

Adjoining the machine-shop is a large stock-room, where a fair-sized supply is maintained, the main stock being stored in the warehouse north of the erecting-shop. Requisitions are made from the stock-room, making it unnecessary to duplicate records in the stock-room and the warehouse. Cards on each bin and drawer show the balance of material on hand serving as a perpetual inventory and also preventing over-stocking.

In the up-stairs wing of the erecting-shop are pattern racks, all patterns being catalogued in a card index. Each card indicates the age and condition of the pattern, together with any notes of interest regarding the same.

Graphitization of White Cast-Iron Upon Annealing

A PAPER by P. D. Merica and L. J. Gurevich of the U. S. Bureau of Standards on 'Graphitization of White Cast-Iron upon Annealing' is to be presented at the September meeting of the American Institute of Mining and Metallurgical Engineers. The authors summarize the most important facts regarding the formation of graphite, both during cooling at casting and upon annealing as follows:

1. Whether a given mass of molten iron becomes white, mottled, or gray upon casting, depends on its composition and its rate of cooling through the temperature range of solidification and immediately below.

2. The more rapid the rate of cooling, the less is the extent of graphitization.

3. Graphitization increases with increase of carbon or silicon content; it decreases with increasing sulphur content. Manganese plays a double role, by combining with the sulphur it first neutralizes the specific effect of the sulphur; but an excess of manganese restrains graphitization.

4. Upon annealing irons that have solidified white, the combined carbon decomposes into graphite or temper carbon at temperatures from 700° to 1100°C., depending on the period of annealing and the composition of the metal. Those elements that promote graphitization upon casting and solidification promote it also during annealing by lowering the temperature range within which decomposition of the cementite is possible.

5. After nuclei of graphite have once formed, further graphitization proceeds more readily and at lower temperatures than in iron of the same composition in which no nuclei are present.

Experiments were made on specimens of white cast-iron of different compositions, and the following conclusions are given:

1. The temperature of initial precipitation of temper carbon for 6 hours of annealing was not noticeably affected by variation of sulphur content from 0.10 to 0.20%, or by variation of total carbon content from 3.60 to 3.90%, although the effect of greater carbon content is to narrow the temperature range within which graphitization is complete.

2. The temperature of beginning precipitation of temper-carbon was about 830°C. for the 6-hour period of annealing, and about 730°C. for the 48-hour period. The maximum allowable temperature, therefore, for the annealing, or 'pitting', of car wheels is about 730°C.

3. After complete decomposition of all free cementite by annealing at from 1000° to 1100°C. and cooling at equal rates in a laboratory electric furnace, less graphite is found in a specimen cooled from 1100°C. than in one of the same composition cooled from 1000°C. This indicates that graphite separates directly from solid solution upon cooling, when its nuclei are already present.

4. The fact that only 0.20% of combined carbon was found in some specimens after annealing at high temperatures and cooling slowly in the furnace would indicate either that the graphite eutectoid lies at much lower values of carbon content than has been previously supposed, that there is at those rates of cooling a direct precipitation of graphite eutectoid, or that there is a formation of graphite from pearlite at temperatures directly below that of its formation.

WHEN Noah built the Ark, there were a number of persons that knocked the project. Later these people were drowned. This is said to be the only case where a bunch of knockers got their full deserts.

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Steel Works at Mont St. Martin

Shaft and Plant at Bethune

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'Safety First' at the Holt Plant

By A. T. PARSONS

WHILE the Holt Manufacturing Co. has, like other progressive concerns, always tried to keep accidents at a minimum, the first really organized effort in the direction of 'Safety First' at the Stockton plant was commenced in 1915 at the instance of P. Ehrenfeldt, secretary and auditor for the company. From this beginning an organization has been developed that for efficient accident prevention is the equal if not the superior of any in California.

Safety work is under the general direction of E. W. Cummings, plant and safety engineer, and of a Central Safety Committee, composed as follows: E. W. Cummings, chairman; J. F. Griffin, manager of the casualty department; W. Barth, committeeman at large; W. C. Kinderman, electrical department; A. G. Lillybridge and F. B. Brooker, machine-shop 'block'; George Flood and G. T. Arthur, tractor-assembly 'block'; J. M. Bond and F. E. Dorf, foundry 'block'; George McFarland and Paul Conchite, harvester-assembly 'block'; Carl Tremain, office 'block'; Peter Conchite, plumbing and sheet-metal department, safety-guard and equipment department; R. Fakkema, inspector of cranes and cables; and Sid Southwick, inspector of fire-apparatus. The 'blocks' or departments each occupy approximately a city block, 300 by 300 ft. The central committeemen are, as a rule, superintendents or assistant superintendents in their departments. Each central committeeman is the head of a sub-committee of five to seven men who assist and advise with him regarding the placing of machine-safeguards and other changes desirable. Boxes for safety suggestions are placed in various conspicuous places around the plant and the workmen are encouraged to make such suggestions either by depositing them in the boxes or by taking up matters directly with the committeemen.

The company maintains a hospital on the factory premises, with a competent staff in attendance day and night. This department is under the direct charge of Dr. Ellis Harbert, a man of wide experience and a skilful surgeon. He is assisted by Dr. L. M. Haight and Dr. A. E. Edgerton, while Miss E. McCartan, a registered nurse, and W. F. Miller, render 'first aid'. All 'first-aid' cases and minor injuries are treated at the company hospital. More serious injuries, requiring bone setting or operations, after 'first-aid' treatment at the company hospital is administered, are handled at a local hospital, where the company maintains a private ward.

Every new employee upon commencing work is handed a small folder, printed in English or Italian, and containing the following safety rules, which he is requested to read carefully:

"1. DO be careful at all times. Carelessness goes before an accident.

"2. DO make suggestions and report dangers you see to a Safety Committee member.

REGULAR MONTHLY MEETING OF THE CENTRAL SAFETY COMMITTEE, JULY 9, 1919. FRONT ROW, READING FROM LEFT TO RIGHT, W. BARTH, GEORGE FLOOD, A G. LILLYBRIDGE, W. C. KINDERMAN, PAUL CONCHITE, J. M. BOND. REAR ROW, PETE CONCHITE (STANDING), F. B. BROOKER, G. T. ARTHUR, GEORGE DITZ, E. W. CUMMINGS, SAFETY ENGINEER AND CHAIRMAN, A. T. PARSONS, ASSOCIATE EDITOR 'METAL TRADES', CARL TREMAIN, F. E. DORF (STANDING).

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"3. DO NOT wrestle, fool or run through plant, and practical joking is strictly forbidden.

"4. DO NOT fail to report at once to foreman, Factory Hospital, or to Safety Committee member, all injuries, however slight.

"5. DO NOT permit any articles to remain in your eye over night or permit any one except the doctor or nurse to remove the particles.

"6. DO NOT work where sparks, chips or emery dust fly, without goggles. This applies especially to chipping, grinding, and pouring. Goggles are provided free by the company. Ask your foreman for a pair.

"7. DO NOT use rickety ladders or ladders without safety feet.

"8. DO NOT allow boards with projecting nails to lie around anywhere.

FIG. 1. SAFETY BULLETIN ON WEARING GOGGLES

"9. DO NOT place material so that it can fall.

"10. DO NOT work around molten metal, unless you wear congress shoes.

"11. DO NOT use tools with mushroomed or burned ends, or hammers with cracked or broken handles. Report to foreman.

"12. DO NOT walk or stand under moving loads on cranes.

"13. DO NOT run a machine you are not supposed to run, or do not understand how to work.

"14. DO NOT remove safety guards from your machine.

"15. DO NOT wear loose or torn clothing, as it is liable to cause you injury by getting caught in moving machinery.

"16. DO NOT clean, oil, or repair a machine while in motion except on orders from your foreman.

"17. DO NOT place your hand where your eye cannot follow. Think twice.

"18. DO NOT fool with electricity.

"19. DO NOT take short cuts over dangerous parts.

"20. DO be careful how distillate and oils are used. They are dangerous and explosive.

"21. DO NOT cause a fire. Protect the company property and your own employment.

"Carelessness is at the bottom of more avoidable accidents than any other known cause.

"A pay check is bigger than a relief check.

"Many accidents are caused by fooling, horse-play, and detracting the attention of others.

"If the boss pasted a ten-dollar bill on the bulletin board, would you stop and look at it? He pastes a good many hundreds of dollars there every year in the shape of Safety bulletins. Do you read them?

"Remember the new man coming into the plant is not familiar with all the dangers around him. Help teach him.

"Don't kid about Safety—you may be the goat.

"Careful workmen always make good and are seldom injured.

"The man who will not listen to Safety rules may have to listen to the sound of the ambulance.

"It is easy to make a first payment on a home of your own. Safety First will help insure the following payments.

"You don't need to know the whole alphabet of Safety. The a, b, c of it will save you if you follow it. Always Be Careful."

The folder also contains information regarding the hospital as well as the clubhouse which the company maintains on the premises, which contains reading rooms and a dining room where lunches are served during the noon hour.

Bulletin-boards are placed in every department in some conspicuous place, usually near the time-clock, on which are posted the bulletins issued by the National Safety Council, and also various 'home-made' bulletins, which, on account of their local appeal, are frequently more effective in arresting the attention than those prepared by the Council. One of these home-made posters is shown in Fig. 1. The man in question was chipping concrete when a large piece flew up and hit the tough glass of his goggles with such force as to break a small hole in them. Two small pieces of glass were removed from his eye at the hospital, but the eye-ball was uninjured. Had he not been wearing goggles, he would undoubtedly have lost his eye, and possibly his life. Needless to say, that man and his entire gang are now firm believers in the importance of wearing goggles.

Another home-made bulletin is the one given below. The reader's attention is caught by the humorous vein in which it is written, but by the time he has finished reading it, several important safety facts have been impressed upon his mind, more forcibly in all probability than if the bulletin had been written in a different way:

WHY WORRY?

"Of two things one is certain—either you have to work or you don't have to work. If you don't have to work there is *no need to worry*. If you have to work, of two things one is certain—either you work in a shop with a safety committee or you work in a shop with no safety committee. If you work in a shop with a safety committee, there is *no need to worry*. If you work in a shop with no safety committee, of two things one is certain—either you are resting in a safe place or you are exposed to danger. If you are resting in a safe place, there is *no need to worry*. If you are exposed to danger, of two

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things one is certain—either you do things the safe way or you don't do things the safe way. If you don't do things the safe way, of two things one is certain—either you 'get away with it' or you don't 'get away with it'. If you 'get away with it' for a while you *may not have sense enough to worry.* If you don't 'get away with it', of two things one is certain—either you get fired or you get hurt, if you get fired you do your worrying somewhere else. If you get hurt, of two things one is certain—either you are hurt slightly or you are hurt seriously. If you are hurt slightly you go to the first aid and after that there is *no need to worry.* If you are hurt seriously, of two things one is certain—either you recover or you die. If you recover there is *no need to worry.* If you die you *can't worry.*"

Once a year a factory picnic is held at a park near town. The entire plant is closed and all employees prepare for a day of pleasure as the guests of the company. The program for the day includes the usual athletic contests, music, games, and dancing, but opportunity is given, without being too obtrusive, of impressing the importance of 'Safety First' upon the assembled company. For instance, at this year's picnic, Will J. French, a member of the State Industrial Accident Commission, gave a talk on 'Safety' and a safety moving-picture film was shown. Fig. 2 shows the bulletin-board displayed at the picnic. Some of the bulletins shown are of the 'home-made' variety. Plans are now under way for the chartering of one of the local moving-picture theatres occasionally and the giving of a performance including a safety-first talk and safety films, to which all employees of the company and their families shall be invited.

Once a month, the Central Safety Committee meets for dinner, after which a general discussion takes place. The members of the committee from each block present a report on what has been done in their department during the month, together with whatever recommendations they may consider advisable regarding future safety work. The following report presented at a recent meeting from the foundry block gives a general idea of the character of these reports and of the thoroughness of the work behind them:

"1. The new elevator has been installed and is now ready to operate. This elevator is well safe-guarded, and removes all chance of danger from a falling elevator.

"2. The platform containing the hoisting-engine for the old elevator and also the stairs leading to the platform have been removed, thus taking care of recommendations made by the inspector for the Industrial Accident Commission.

"3. The starting-switch for the cupola-blower has been removed from the platform back of the cupola to the tap-out platform, which makes it easy of access for the cupola-tender in case of emergency.

"4. The insulation of the cable for the lifting-magnet became broken, and came in contact with the hoisting-cable of the magnet. This was burned in two, allowing the cable to fall. Both cables have been replaced by new ones, and a winding-device that will keep all slack out of the cable is being installed so that this accident cannot happen again.

"5. The location of the rope controlling the switch on

FIG. 2. SAFETY BULLETIN BOARD AT HOLT PICNIC

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the foundry monorail was found to be so close to the switch-opening that the operator would be in danger of running off the end of the track if the safety-stop failed to work. This rope has been lengthened so that there is now plenty of room between the operator and the open switch.

"6. It was noticed that loose boards were lying overhead, having been left there by the workmen on various occasions. These were taken down.

"7. We suggest that action be hastened on the order placed on the sheet-metal department for a guard over the emery-wheel by the south door of the cleaning-room. This wheel is so close to the door that a person passing through could very readily put his hand on the wheel.

"8. A permanent ladder has been built to the motor on top of the brass-foundry office, and a hand-rail has been built around the edge, making it much safer for the oiler and repairman, and providing ease of access in case of fire.

COMPANY HOSPITAL

Reading from Left to Right: Dr. A. E. Edgerton, Dr. Ellis Harbert, Physician and Surgeon in Charge, Patient, Dr. L. M. Haight, Miss E. McCartan, W. F. Miller, J. F. Griffin.

"9. An iron staircase has been installed to the tapping platform for the north cupola, replacing the wooden ladder that was formerly used there."

Where recommendations are made in the reports, opportunity is given for discussion and the meeting also considers any other general safety matters. At the July meeting it was decided that at future meetings, a statement should be obtained from the hospital concerning the serious injuries during the preceding month. The causes of each accident will then be discussed as well as the methods of preventing similar accidents in the future.

The meetings of the Central Safety Committee are generally attended by George A. Ditz, of Neumiller & Ditz, attorneys for the company. Mr. Ditz has made a special study of workmen's compensation laws, particularly the California act, and in the general discussion is able to give interesting instances of the application of the act. This tends to broaden the vision of the members of the committee and gives an added interest to their work.

In addition to the reports already mentioned, a monthly report on the condition of all wire cables and hoisting apparatus is submitted by the inspector of cranes and hoisting apparatus. The reason for this monthly inspection is given in the following extract from the first report. "Every item of equipment mentioned herein is at all times under direct supervision of a foreman, who is in charge of the department where the hoisting apparatus is used. But the apparatus may be situated or used where it is not easy to see whether or not everything is in good working condition. Therefore, a special inspector will make a thorough inspection once a month." The form of the report is shown by the following extract:

Mill Block

Department	Description	Remarks
Plow assembly	2-ton jib-crane, 47 hp. Sprague electric hoist, ⅜-in. steel cable.	Good condition
	Cable dead-end fastenings.	Good condition
Stores 24	No. 1507, Chicago Pneumatic 1-ton air-hoist, ⅜-in. steel cable.	Good condition
	Cable dead-end fastenings.	Bad condition

On the last page of the completed report, we find the following note regarding the fastenings noted above as being in bad condition.

"Mr. E. W. Cummings:

Subject: air-hoist in Stores 24

Have repaired the cable-end fastenings with two cable-clamps in dead-end and also new clamp on live-end of cable.

Signed ———"

A complete inspection of all machinery and safeguards in the plant is made each month, and a report made to Mr. Cummings in the following general form:

Machine Shop

Machine number	Kind of machine	Remarks on guards
85	Turret-lathe	O.K.
86	Lathe	
88	Engine-lathe	O.K.

Where the space under 'Remarks' is blank it indicates that the machine has no guard. This may be because the character of the machine is such that guards are either unnecessary or impractical, or because, on account of the recent installation of the machine it has not so far been possible to devote the necessary time to making and placing a guard. Machines in this latter class have, however, become 'few and far between' in the plant. If a guard is not in good condition, it is so noted in the 'Remarks' column, and the report is not considered closed until a supplementary report is made stating that the guard has been repaired. At first this report on machinery was made by a special inspector for the entire plant, but it has been found better to have the inspection for each 'block' made by the various members of the Central Safety Committee.

As already noted, the company supplies goggles and insists on their use wherever there is danger of any kind of foreign bodies entering the eye of the workman. A

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sufficient extra supply is kept on hand so that all goggles can be turned in at stated intervals and sterilized. The company also encourages the use of various kinds of protective clothing, such as leggings for the ladle-men in the foundry. The regular guard used for belts, emery-wheels, and similar hazards is made of either sheet-metal or of wire netting in sheet-metal frame, according to the special type of hazard. Various special guards and devices are used for special hazards.

But while the company working through Mr. Cummings and his Safety Committee is well up-to-date in their use of all kinds of safety devices, and the use of such devices has, without doubt, prevented many serious accidents, the most noticeable feature of the safety work at the Holt plant is the way in which the 'Safety-First' idea has permeated the entire working force of the plant. The men think 'Safety', and consequently do things in a safe way. Furthermore if an employee notices something about the plant that looks unsafe, he does not say "Oh, well, it's none of my business," but he goes right away and reports it to the safety engineer or to a committeeman. An instance of this was recently furnished by the case of a plumber, an old employee of the company, who, when the safety work was first started, was inclined to be scornful. By degrees, however, he came around to a more rational viewpoint, and is now one of the company's most valuable 'safety-men', since his work takes him in out-of-the-way places, and enables him to observe conditions that escape the attention of the ordinary workmen, or even the foremen. Recently he discovered that a heavily-loaded roof-truss was in a dangerous condition. One end of the truss rested on a block fastened to a column. Shrinkage of the truss and settlement of the sides of the building had reduced the bearing of the truss on the block to an amount so small that crushing of the fibres of the wood of the block had commenced and the collapse of the truss might have happened at any time, wrecking the building and probably killing several men. While he did not realize how serious the condition was, 'the thing did not look right' to him, and he reported it. Needless to say, a gang of carpenters was rushed to the work and the building repaired.

Instances of the 'Safety-First' spirit of the employees might be multiplied. In fact, one of the safety committeemen said at a recent meeting that he believed most of the workmen would refuse to work at many plants with which he was acquainted, because of the lack of safety measures at those plants. While such a remark can be attributed, in part at least, to enthusiasm and 'plant patriotism', it must be remembered that this same enthusiasm and *esprit de corps* is in itself an important asset, both in safety work and to the general interests of the company.

While the success of the safety work is mainly due to Mr. Cummings and his associates on the Central Safety Committee, a large part of it should also be attributed to the general spirit at the plant. The expression, 'the Holt family', has no empty meaning, as the relations between general officers, superintendents, and foremen, and workmen, as well as between the different departments, are as close or closer than in the average small plant. If a workman has something to say, he says it to the man that should hear it, no matter what his position may be in the company, and he is sure of a respectful hearing.

So much for the safety work itself. Let us now see what has been accomplished. The report for 1917 shows an average payroll of 2125, and the average number of injuries per month was 284, giving a monthly accident rate of 13.4%. It should be noted that this included every injury, however slight, that received attention at the hospital, including even some injuries received outside of working hours. The number of injuries per month serious enough to cause any lost time at all was about 20. In only 102 cases was any compensation paid under the Liability Act, amounting in all to $14,656.57. Of this amount, $10,024 was paid in 10 cases of major injuries, ranging from the loss of a finger to the loss of a leg.

The year 1918 was marked as in other plants, particularly those engaged like the Holt factory, in war work, by high labor turnover, unintelligent labor supply, night work, and rush work. Consequently, an increase in the accident rate over 1917 might have been expected. On the contrary, the monthly accident rate was reduced from 13.4% to 12.4%. The average number of employees in 1918 was 2289.

Other interesting facts shown in the hospital reports for the years 1917 and 1918 include the following: The number of accidents is relatively small for the first hour of work, between 8 and 9 a.m. A slight peak is reached between 9 and 10, and the rate then decreases gradually until noon. After resuming work at 1 p.m., the next hour shows the lowest accident rate of any period of the day shift, but this increases steadily until between 4 and 5 p.m., the last hour of work, when the rate is nearly double the average for the day shift. Data regarding the number of men working on the night shift have not been compiled sufficiently to permit comparison of the rate for the night shift with that of the day shift. The 'Monday peak', so frequently noted in accident reports is absent. The greatest number of accidents occurred on Tuesday in 1917 and on Wednesday in 1918, but there is little difference in the number of accidents occurring on any of the five full days of the week. March showed the largest accident rate in 1917 and August in 1918, but this was probably on account of other causes. In fact the figures indicate that neither the month of the year nor the day of the week has had any particular bearing on the accident rate. In spite of the strenuous campaign for the use of goggles, eye injuries lead the list, with 39% of the total number of injuries in both 1917 and 1918. Finger injuries come next with 33% of the total in both years. Hand injuries, the next on the list decreased from 10% to 8½%. An indication of the progress of the work of safeguarding the emery-wheels, now practically complete, is found in the reduction of emery-wheel accidents from 401 in 1917 to 33 in 1918.

Another very tangible result of the safety work is indi-

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cated by the action of the State Compensation Insurance Fund in re-rating the company. The company is allowed the maximum possible credit of 10% under the subject of safety organization, inspection, and education. An additional credit of 2%, the maximum allowed, is given under 'First Aid and Hospital' because a trained nurse is in attendance at the plant at all times and the services of a registered physician are available. Other credits, based principally on the favorable physical conditions created by the work of the Safety Committee, amount to 9.8%, making a total reduction of 21.8% in all merit rateable insurance rates. This represents a substantial annual saving in premiums. In addition, the company received a return from the profits of the State Fund, over and above the cost of insurance, several hundred dollars

FORM NO. 718

Fire Notice!

Block Supts. Report

Date 2/28/19 Time 3:45 PM Building No. 3

Title of Building MACHINE SHOP BLOCK Department HEAT TREATING

Caused by Oil boiling over when tempering steel.

Extinguished by Workmen using 1 2½-gallon extinguisher.

Was alarm given by Fire Alarm System No Was Fire Brigade called No

Time Fire Brigade arrived

Extent of damage done by fire 5-gallon of linseed oil

Report made out by A. G. LILLYBRIDGE

Plant Engineer's Report

Value of Damage $ 10.00 Remedy made to avoid future fires

Keep oil from getting overheated.

Was fire accidental or otherwise Accidental.

E. W. CUMMINGS. Plant Engineer.

ALL fires must be reported, no matter how small, and five copies must be mailed to Plant Engineer immediately; retain one copy for your files. Further remarks can be made on the back if necessary.

FIG. 3. FIRE REPORT

larger than the amount that would have been received had the accident rate been higher because of a less efficient safety organization. No definite estimate can be made of the amount saved through the reduction of the many other losses caused by accidents, such as overhead on idle machines, and decreased morale in an entire department immediately following an accident. However, the saving in premiums alone is several times the maximum expense properly chargeable to the safety work.

Simply as a business proposition, irrespective of the humanitarian standpoint, the safety work of the Holt company pays. But the humanitarian standpoint should not be neglected. The suffering saved, both of the man himself and of his family, the years of privation that may follow an accident (65% of a man's wages does not keep the wolf very far from the door), who is there that can place a money value on these intangibles?

Fire protection, is, with good reason, included as part of the safety work at the Holt plant. Besides the city mains and hydrants, a complete system is maintained by the company itself. There is a 100,000-gal. steel tank on a steel tower, maintaining 15 lb. higher pressure than in the city mains. The two systems are inter-connected, but a check-valve separates the systems as long as the pressure in the company mains is higher than in the city system. If, however, the pressure in the company mains should fall, the valve would open automatically. In addition a large number of hand extinguishers, water-buckets, water-barrels, and small chemical engines on two-wheel hand-trucks are maintained about the plant. All this apparatus is inspected monthly, and a report similar in form to those made on the cables and hoists and the machine-safeguards is made to the safety engineer. Men are assigned to handle each piece of the fire apparatus, and frequent fire-drills are held, at which there is much good-natured rivalry between the various departments. After all fires, however small, a report is made on the form shown in Fig. 3 to the safety engineer by the member of the Safety Committee in whose department the fire occurred. A regular fire-engine house of the city department is maintained at the plant, the company having paid outright for the building, and having advanced the cost of the engine until the city is able to repay this amount. The agreement with the city provides that this engine is not to be called away from the plant except in the case of a general alarm requiring the entire fire-fighting equipment of the city.

Acknowledgment should be made to the officers of the Holt Manufacturing Co. and the members of the Central Safety Committee, particularly E. W. Cummings, who, by their cordial co-operation, made the preparation of this article possible.

Electric Welding Cutting-Tools

In an article in 'The American Machinist', C. A. Hart states that it is practicable to weld high-speed tool-steel bits to common cold-rolled steel shafting. The best results are obtained when the thickness of the tool-steel is from ¼ to ⅓ the thickness of the tool. Care must be taken in welding, as the high-speed steel offers greater resistance to the current, and therefore heats more quickly than the common steel. As the copper points used in welding are subject to great heat and pressure, they should be cooled by a stream of water passing through them while in use. When both metals have reached a welding heat, the current is cut off and pressure applied. A flux is not needed, but the use of a solution of borax water is sometimes advantageous. To temper, plunge while white-hot into oil. The stock should be heat-treated or annealed to keep the high-speed steel from checking or breaking.

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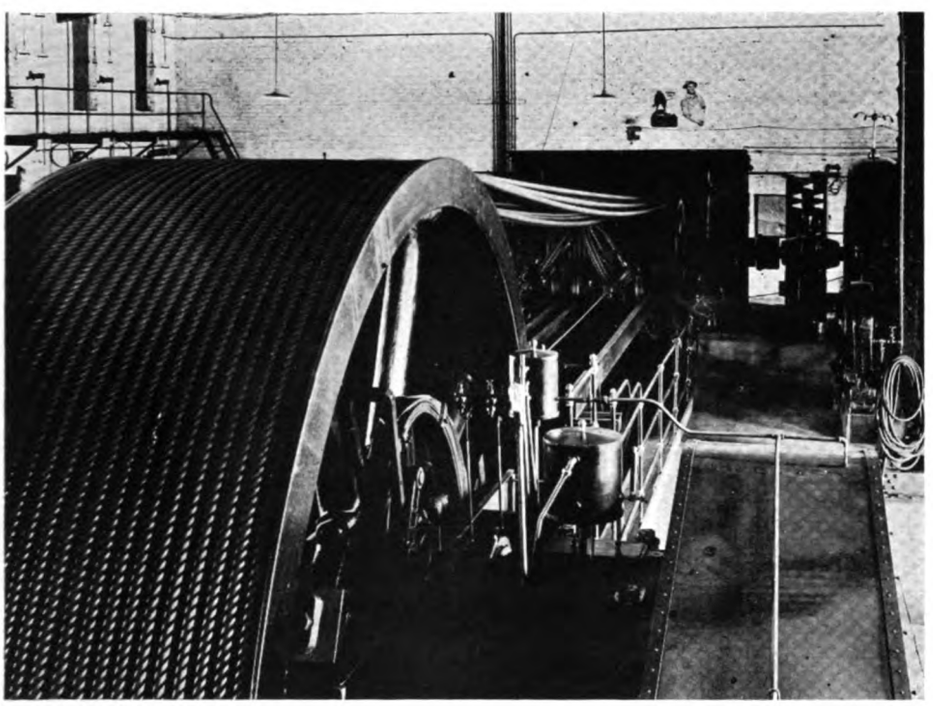
Manila Rope Drives

By H. T. HESSELMEYER

AMONG the several methods that are in daily use for the mechanical transmission of power, manila rope possesses features that, under certain conditions, make its application a necessity, and this is particularly true for large amounts of power.

Manila transmission-rope is manufactured from the fibre of the abaca plant, which grows in the Philippine Islands. From the long leaves that enfold the trunk of this plant is procured the fibre so well suited to the requirements of rope. This fibre is usually from 6 to 12 ft. long, and even attains a length of 16 ft. It has a remarkably high tensile strength which, however, is shown only with the grain, while across the grain or transversely, it is relatively weak.



AMERICAN SYSTEM DRIVE IN POWER-PLANT OF NORTHWESTERN PACIFIC RAILROAD AT ALTO. NOTE TENSION-CARRIAGE

The best rope is manufactured with great care so as to keep in mind these features, and it is made with 3, 4, and 6 strands, three-strand being without core, while both of the others have an inner core. Some manufacturers believe that three-strand rope should be used for all diameters. Others say that for small drives, using rope up to 1 in. diameter, three-strand is most suitable, while in larger sizes four strands, being rounder and more flexible and slightly stronger, is best.

*Chief engineer, Meese & Gottfried Company.

Rope driving is done by two different systems, called respectively the multiple or English system and the continuous or American system. Some of the advantages possessed by both systems are as follows:

1. The large amount of power and the distance and direction in which it can be transmitted.
2. Economy in first cost and maintenance as well as in space.
3. Noiseless operation and no electrical disturbance.
4. Steadiness of speed, no loss due to slipping.
5. Safety.

The amount of power that can be transmitted has practically no limit. Large drives of from 1000 to 2000 hp. are numerous. Power may be transmitted with driving and driven sheaves close together if desired, but when shafts are closer than 30 ft., centre to centre, the continuous system is generally used, especially at high speed, for in the multiple system, a small amount of stretch of rope will so decrease the initial tension that centrifugal force carries the rope out of the groove and thereby diminishes its driving capacity.

Power can be satisfactorily transmitted where the distance between shafts is 150 ft. without supporting idlers, but usually supporting idlers are used 60 to 80 ft. centre to centre. In large drives rope has a great advantage over leather belting, not only in first cost and maintenance but also in safety. In the matter of first cost, no comparison can be made for drives above 1000 hp. and where the centres of shafts are nearer than 25 ft., or further apart than 35 ft., rope is decidedly superior for smaller powers.

With drives from 150 hp. up, and where shafts are 25 to 35 ft. centre to centre, the cost for belt-drives is 10% to 30% more than for rope-drives, varying with the distance and size of drives. The margin increases rapidly as the distance between centres increases.

The cost of maintenance of a properly designed rope drive is small, and this is a strong point in its favor. Taking the average life of such a rope at 8 years, a belt

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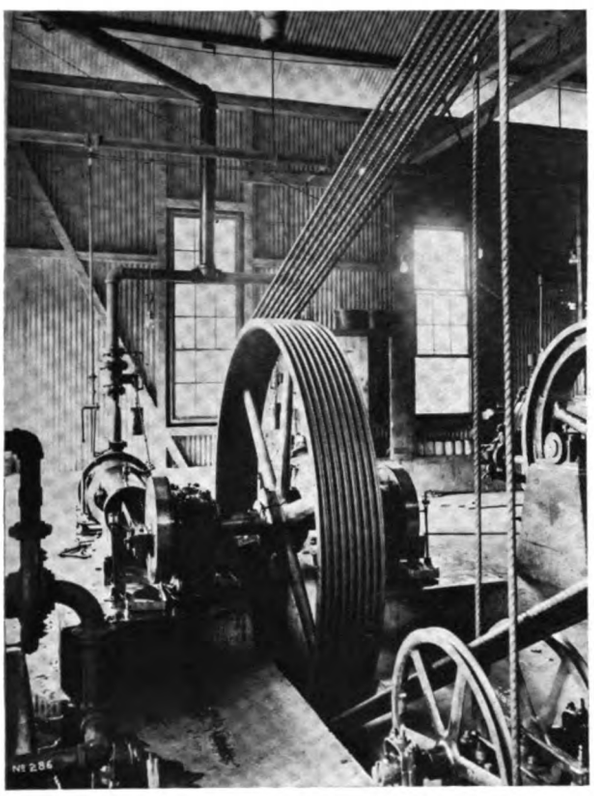
would have to run 1½ to 2 times as long to give equal economy.

For drives of equivalent powers the sheaves required for rope are much narrower than the pulleys for leather belting, sometimes as much as 50 to 60% narrower, varying with the size of rope used.

A rope drive is noiseless at all times and free from vibration. The rope being flexible enters silently on the grooves in the sheaves, and the quiet way in which it performs its work in comparison with belting is marked. In small as well as in large drives, this silence is noticeable, though the ropes may be running a mile a minute.

There are none of the electrical disturbances frequently occurring with belt drives, and which are the cause of



ROPE-DRIVE AT A MINE POWER-PLANT

so much annoyance when handling material in some industries.

Absence of slip is another great advantage. While there is perhaps a small amount of slip, it is negligible, particularly so when large sheaves are used. It is seldom necessary to make allowance for slip in calculating speeds of shafts.

Perfect safety is assured with rope drives. A rope will invariably show weakness long before the danger-point comes, giving time to make repairs, for such a defect is easily detected even while the drive is running. This allows time to stop and make repairs before the rope separates. Simple devices are in use to give warning. Ringing an electric bell calls the attention of the engineer to the trouble.

We will now consider the multiple system. It is the simpler of the two, consisting merely of two sheaves with as many grooves suitable for ropes of proper diameter to give the desired horse-power, no idlers nor tension-sheaves being used in this system.

One of the earliest applications of rope drives was by James Combe in the Falls Foundry at Belfast in 1856. Single endless ropes were used, and from the amplification of this plan has been evolved what is now termed the multiple system. It consists of a number of endless ropes working side by side in suitable grooves in the sheaves, the weight of the rope giving the necessary tension. The ropes are pinched in the groove for the proper adhesion. In this system, each rope is spliced separately, and is a unit by itself. For this reason, it is often contended that all the ropes do not pull the same. This, however, is erroneous for the longer rope is doing just as much work as the shorter because of the greater arc of contract in the groove, and as the pitch diameter of all grooves must be alike, the speed of all ropes is the same. One of the advantages claimed for this system is that it gives great security against break-downs because it is hardly probable that more than one rope will fail at the same time, and, should a rope break or give warning of failure, it can be repaired or, if necessary, cut out entirely without causing delays.

This system is best adapted for large powers in simple direct drives at moderately high speed. The sheaves should be of large diameter, and must be on shafts parallel to each other or nearly so, and may be from 30 ft. up to as much as 100 ft., centre to centre. The ropes should be either horizontal or else slightly inclined but never vertical, consequently the system is limited in its application and the conditions must be favorable.

The continuous or American system of rope driving, on the other hand, is so flexible, so universally adaptable, and so much more satisfactory than the multiple system, that its application is almost unlimited. The distinguishing feature of this system is the traveling weighted tension-carriage, which controls and regulates the proper tension.

In the American system one continuous endless rope is wound around the driving and driven sheaves as many times as are required to give the desired amount of power. It is necessary to pass the rope from the outside groove of the driving sheave to the opposite outside groove of the driven sheave by means of the above mentioned tension-sheave mounted on a carriage arranged to travel to and fro, automatically keeping a uniform tension throughout the drive, taking up any slack that may occur when the rope stretches or the load varies. The principle involved in the maintenance of the tension is most important, and every precaution must be taken that it is not violated. All slack must be taken care of where it accumulates, which is on the slack side of the driving sheave. This is accomplished in two ways: First, by leading the rope from the last or outside groove of the driving sheave to a stationary idler-sheave, then to the tension-carriage, and after passing around the tension-sheave back to the opposite outside groove of the driven

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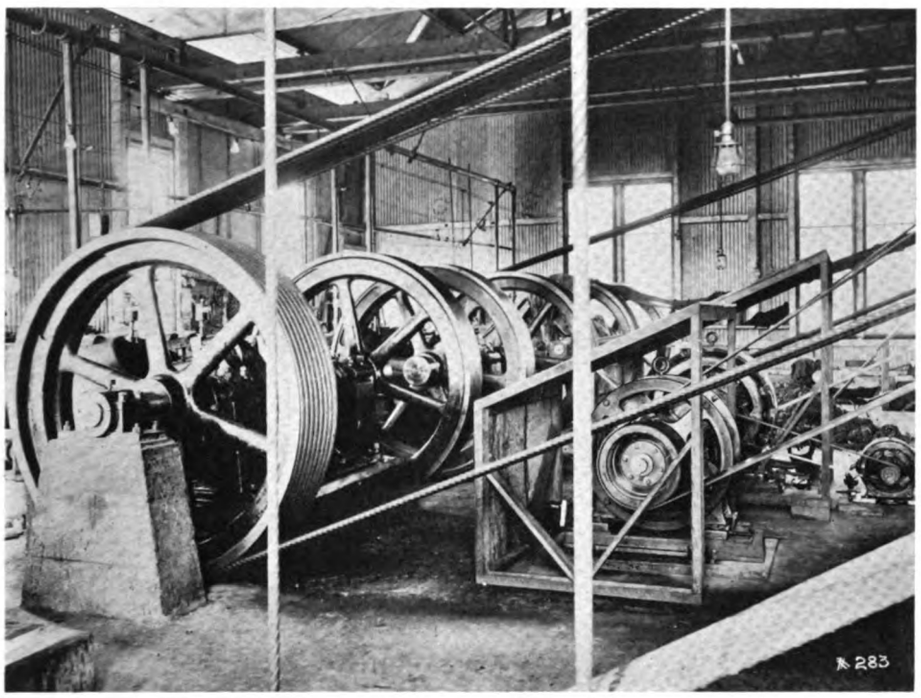
sheave. Second, where it is inconvenient to take the slack directly from the driving sheave, the same result may be obtained by taking it from the driven sheave. The rope must pass from a loose or rewinder sheave, which is placed alongside of the driven sheave to the sheave on the tension-carriage, and then returned to the opposite outside groove of the driven sheave. With proper adjustment of weights the traveling carriage can be made to give just the correct tension to suit conditions. With this system it matters not whether the drives are horizontally inclined or vertical, whether the distances centre to centre are small or large, whether the tight side of ropes is top or bottom, whether the speed is high or low, or whether the load is variable or steady, the automatic tension-carriage makes successful operation possible. The continuous system is suitable for small as well as great powers. The sheaves need not be parallel or in the same plane. It is especially adapted for right-angle drives, operating shafts on various floors, and when other complicated conditions exist this system cannot be excelled.



DRIVES WITH INCLINED ROPES

It must be remembered, however, while the American system can meet these conditions, it requires proper care in design, so that all the benefits may be realized, for a definite design can be obtained to suit every case exactly, and this calls for the best engineering experience, theoretical and practical. A correctly designed and properly installed rope drive is really pretty when in operation and is most satisfactory in service, but it is most troublesome and expensive when incompetently handled.

Let us now consider the design of a rope drive. After having determined the amount of power to be transmitted, and knowing the revolutions per minute of the driving and driven shafts, the first thing to consider is the size of the sheaves. The most economical speed at which to run the rope is probably about 4500 ft. per minute, taking into consideration first cost and durability. Of course, lower speed increases durability while higher speeds up to certain limits, say 5000 ft. per minute, reduce first cost. If we assume the rope speed of 4500 ft. per minute, and the revolutions of the driving shaft at 340 per minute, we proceed to find the diameter of the sheave for this shaft in the usual way. By dividing we have a circumference of 13.2 ft., multiplying this by 12 and dividing by 3.1416 we have a sheave diameter of 50 in. After having determined the diameter of the sheave we proceed to select a rope of proper diameter. This is important. More rope-drive failures have been caused by using sheaves too small for the rope than from any other reason. This is because transmission ropes wear first on the inside by the movement of the fibres on each other and become disintegrated under pressure in passing over the sheaves. Bending and straightening of the rope in going on and off the sheaves is continually occurring, and excessive bending must be avoided if the rope is to last for a reasonable length of time. External wear is caused by wedging in the grooves of the sheaves, and as all good ropes revolve in service, this wear on the outside is uniform.

In order to reduce wear to the minimum, experience has shown that the diameter of the sheave should be as large as possible, at least 40 times the diameter of the rope, and larger if great durability is expected and conditions permit. Whenever this ratio is reduced, it is done at the expense of life of the rope.

Having found the diameter of sheave to be 50 in., by applying the rule of 40 to 1 we find the diameter of rope to be $1\frac{1}{4}$ in. For convenience in determining the horse-power that single ropes will transmit, a table has been prepared. From this we find that a $1\frac{1}{4}$-in. rope at 4500 ft. per minute will transmit 29.4 hp., which divided into the total horse-power will give the number of ropes. It is best at all times to select the largest diameter of rope possible with the smallest allowable sheave, for it is better to use a few large ropes than many of small diameter, as the greater wearing surface of a large rope adds to its life. Usually, however, it is not advantageous to use rope larger than $1\frac{3}{4}$ in. diam., 2 in. diam. being used only in large transmissions. An important detail and one that is many times neglected is the splice.

Improper splicing is the cause of many rope troubles.

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The best splice is the one which is nearest the diameter of the main part of the rope, and which will wear the longest without permitting the tucks to unstrand. It must be smooth and without lumps. Splices made by 'any old' sailor are entirely unsuited for transmission work and must be avoided. The perfected splice may be learned by the man in charge of the drive from an expert in a short time. A great deal of attention must be paid to the design of the sheaves, especially their diameter, form of grooves, and trueness while running. The commonly adopted angle of 45° for grooves is the best suited for general service. In the continuous system the rope may be kept tighter than in the multiple system, so that it is the practice to dispense with some of the metal outside of the pitch-line of the rope. In the multiple system the grooves must be much deeper to keep the ropes from jumping out, because of unevenness of the load, should they tend to whip.

It is essential that all grooves in the same sheave be exact duplicates as regards pitch diameter of the rope and identical in shape. They should be perfectly smooth and in fact, polished to give the best results. Some engineers make the angle of the groove in the sheaves more than 45°, occasionally as much as 60°, for which they claim better efficiency as well as thinner and narrower rims, thereby saving space and expense.

As before mentioned, in every continuous rope installation, a traveling tension-carriage is required to take up the slack and produce the necessary tension in the rope. The length of rope that one carriage will govern satisfactorily depends upon the available distance for travel of the carriage, and varies with the nature of the drive and other local conditions. One carriage should not govern more than 12 laps of rope unless the distance between centres of sheaves is short and the maximum amount does not exceed 2500 ft.; but no set rule can be given. The amount of space for travel of the tension-carriage can be estimated at about 2% of the total length of rope under ordinary conditions. The amount of weight required for the tension-carriage varies with the speed and should be enough to give sufficient tension under all conditions to prevent slippage.

After a drive has been installed and is in running order it should be lubricated from time to time for protection against wear. This is especially important for drives exposed to the weather or to warm air, which would dry the rope. Any kind of oil that is free from acid is suitable. Alum mixed with graphite will prolong the life of the rope considerably. There are standard preparations made by rope manufacturers, which are well suited for this purpose, and which, when properly applied, will keep the rope soft and pliable.

Horse-power Transmitted

Speed of rope in feet per minute	Diameter of rope, inches							
	¾	⅞	1	1⅛	1¼	1½	1⅝	2
1000	3.0	4.0	5.0	6.5	7.5	11.0	15.5	19.7
1500	4.25	6.0	7.5	9.5	11.5	16.5	22.5	29.5
2000	5.5	7.5	9.5	12.25	15.0	21.8	29.2	38.7
2500	6.7	9.2	11.8	15.0	18.5	27.0	36.0	47.5
3000	7.8	10.7	13.7	17.5	21.7	31.5	42.0	55.0
3500	8.7	12.0	15.5	20.0	24.5	35.5	48.0	62.8
4000	9.8	13.0	17.2	22.0	27.0	39.2	53.0	69.5
4500	10.5	14.2	18.7	24.0	29.4	42.5	57.5	75.0
5000	11.2	15.0	19.7	25.3	31.0	44.7	60.7	79.0

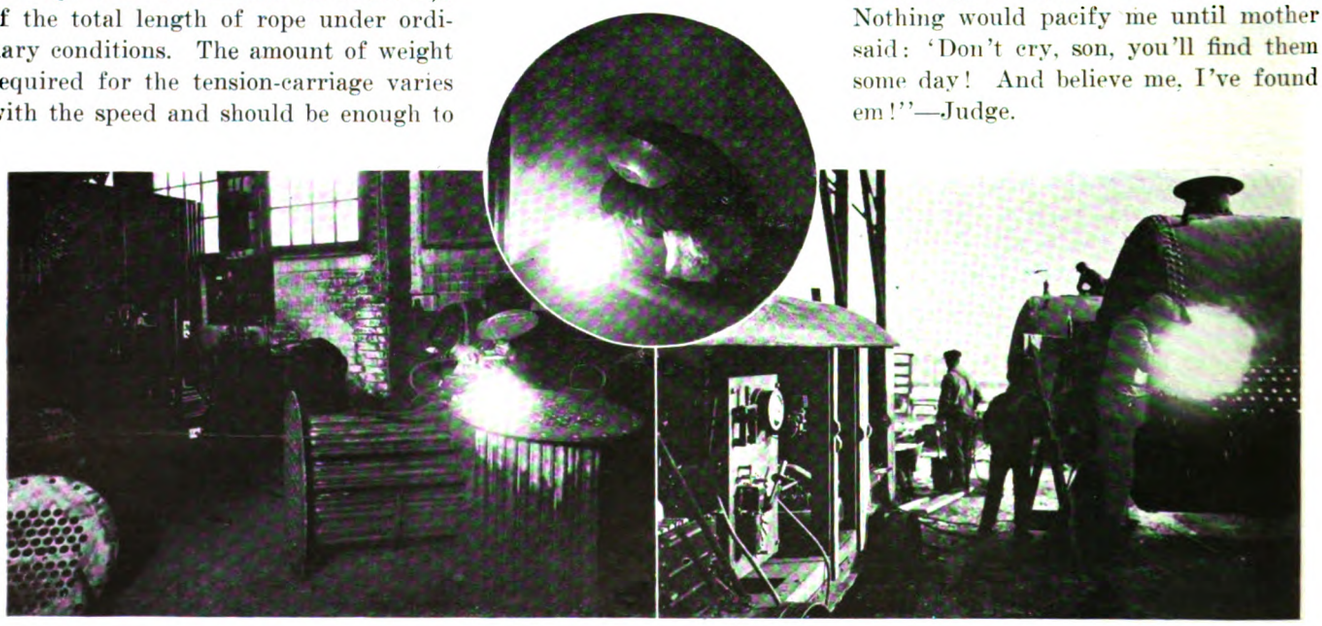
In compiling the above table the formula of J. J. Flather was used, which takes into account the tensions of the tight and loose sides and that due to centrifugal force, and also assumes—

165° arc of contact of rope on sheave.
45° angle of groove in sheave.
0.31 coefficient of friction.
Weight of rope per foot to be equal to 0.34 d^2
Breaking strength of rope to be equal to 7100 d^2
Maximum allowable working tension 275 d^2
d = diameter of rope

For other arcs of contact than 165°, the horse-power given should be multiplied by the following correcting factors:

140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
0.90	0.94	0.98	1.02	1.06	1.10	1.13	1.16	1.20	1.23	1.26

THE sergeant had been working hard to get the awkward squad into shape, with very poor results; so after trying everything he knew, he yelled: "Squad, halt! Stand easy! Now, boys, I'm going to tell you a story. When I was a little tot, mother bought me a box of wooden soldiers, which I happened to lose while moving a few days after, and I cried and cried. Nothing would pacify me until mother said: 'Don't cry, son, you'll find them some day! And believe me, I've found em!"—Judge.



KINDS OF WORK DONE BY ELECTRIC WELDING

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Electric-Arc Welding Equipment

By H. L. UNLAND*

PRACTICALLY all arc welding is accomplished by either the metallic or the carbon electrode method. In the metallic-electrode method, the electrode consists of a wire or rod held in a suitable holder. The heat of the arc, in addition to melting a small pool on the work, melts the electrode and the current causes the molten metal to be driven in finely divided particles against the work. By this method metal can be deposited on vertical surfaces, and it is the only way in which metal can be successfully deposited overhead. The metal deposited by this method is more uniform and a weld so made is stronger and has a smoother and more regular appearance than one made by the carbon electrode. For these reasons the metallic electrode is used when strength or appearance is important.

The carbon-electrode method is used for building-up metal, plugging holes in castings, welding, or for joining parts where strength and appearance are not essential, or where the surface is to be machined off. Since heavy currents can be used, metal can be deposited rapidly. In the carbon-electrode method a carbon rod is used instead of the metal electrode. The arc fuses the metal of the work and additional metal is supplied by melting a rod of filling material in a manner similar to soldering with an iron or welding with a gas-torch.

Welds that are soft enough to be machined can be made by either method if reasonable care is taken. The deposited metal should not be chilled and if the carbon electrode is used the arc should be kept long enough to prevent carbon being carried into the weld. Besides the above causes, the principal reasons for hard welds are poor quality of electrode metal or filling metal.

The deposited metal is obviously cast-steel, since it is merely fused in place and is not ordinarily subjected to any mechanical working afterward. The metal will have the coarse-crystal structure found in unannealed cast-steel and likewise will have comparatively low values for reduction in area and elongation. In some cases the tensile strength of the metal in the weld may be as high as 55,000 to 60,000 lb. A safe figure is 35,000 lb., provided the work is done by experienced welders.

The following table shows the approximate kilowatt-input required for various systems:

	Kw. or Kva.
Alternating-current 100-volt supply	15
75-volt constant potential	15
60-volt constant potential	12
Alternating-current 110-volt supply	7
40-volt constant potential	8
Constant-energy equipment with supply motor-generator set	7.65
Constant-energy equipment operating from 125-volt line	5.35

*Power and mining engineering department, General Electric Company.

If a considerable number of operators be employed, the outfit requiring low input is much to be desired, as the cost of operation is reduced.

There are several principal types of welding equipment among which are:

1. Constant-energy self-excited generator.
2. Constant-energy balancer sets.
3. Constant-potential generator with auxiliary equipment.
4. Alternating-current welder.

All except the constant-potential type are primarily single-operator individual outfits suitable for bare metallic-electrode welding only. The constant-potential type may be used as single-operator equipment for either carbon or metallic-electrode welding or a number of operators may work from one machine. This type of machine also permits the use of the carbon electrode for cutting.

The equipment for each type of apparatus is as follows:

The constant-energy self-excited generator is arranged for belt-drive, or to be directly connected to a direct-current motor or to a 60-cycle 3-phase alternating-current motor. This type may also be direct-connected to 25 or 50-cycle alternating-current motors or to alternating-current motors of any of these frequencies wound for two-phase circuits, the maximum voltage being 550. It can also be direct-connected to gasoline-engines or to other engines with speeds of either 1200 or 1500 revolutions per minute.

The constant-energy balancer-sets are suitable only when 110 to 125-volt direct current is available. If the circuit has the positive side grounded it is entirely satisfactory. If not, special precautions must be taken.

The constant potential generators can be direct-connected to direct-current motors or to a 60-cycle 3-phase alternating-current motor. The equipment is also suitable for connection to gas, oil, or steam-engines.

Alternating-current welders may be used on 60-cycle circuits of 220, 440, or 550 volts. The welder is single-phase, but where several are in use on a poly-phase system they may be distributed among the phases to balance the load in part.

The constant-energy arc-welding generators of the self-excited type are designed to obtain in one machine all the characteristics demanded by arc-welding service. This is obtained without the use of external ballast-resistance or separate excitation from any external source. Since the machine provides its own excitation, the voltage characteristics are such that throughout the proper

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working-range of the arc the energy delivered is practically constant. The voltage and current follow the momentary variation in the arc condition practically instantaneously, and consequently the lag between change in arc conditions and resulting corrective change in electrical conditions is reduced to a minimum. This lag is one cause of trouble in welding with self-regulating welding equipments whether the automatic feature is embodied in the revolving apparatus or is mounted on the control-panel.

The generator is so wound as to give a no load or striking voltage of 60, which, when the arc is struck, automatically decreases to the voltage required by the arc. This is from 18 to 20 volts for the average operator and average good work. A longer arc is undesirable. Skilled operators on smooth work are sometimes able to hold a short arc with a voltage as low as 16, but in rating the generator, 20 volts is used. By adjustment of the dial-switch on the panel, the current may be adjusted from a maximum of 200 to a minimum of 75 in 25-ampere steps.

The constant-energy arc-welding set of the balancer type is a novel type of arc-welding equipment which combines the best electrical characteristics for the arc with high efficiency and light weight. It operates from a 125-volt direct-current supply-circuit, but will also operate on voltages as low as 110. A supply-voltage of 125 was selected because that was found to give the best results, not only from the standpoint of efficiency, size, and weight for the set, but from the standpoint of the distributing system. These characteristics have been demonstrated both from a series of practical tests under commercial operating conditions and from oscillograph curves.

The balancer set is of standard two-bearing construction, built for operation on 110 to 125-volt direct-current supply-circuits. The two armatures are mounted on one shaft and connected in series across the 125-volt supply circuit. One terminal of the welding circuit is taken from the connection between the two armatures and the other from the positive line. By this means each of the machines supplies part of the welding current and, consequently, the size and weight of the machines is minimized. The design of the fields and their connections is such that the set delivers the voltage required directly to the arc without the use of resistors or other energy-consuming devices.

The current control gives six steps of the approximate values 50, 70, 90, 110, 130, and 150 amperes. If intermediate current values are required, they can be obtained by means of the generator field-rheostat.

Arc welding is usually done on metal that is grounded, and this is unavoidable in ship work, where the ship structure is always well grounded. Since successful operation requires that the positive terminal be connected to the work the supply-circuit should be arranged so that it can be grounded on the positive side with entire safety.

In the constant-potential arc-welding generators any direct current can be used for welding, but the voltage must be reduced to values from 20 to 50 volts. One method of obtaining this condition is by using a constant-potential supply-circuit and inserting resistance in series with the arc to absorb the excess voltage. This is an inefficient method of operation with the ordinary-supply circuits as the voltage absorbed by the rheostats is a large part of the total energy. If the supply circuit is 550 volts and the metallic arc is being used at 20 volts, the energy used is only a small fraction of that taken from the line. In order to avoid these losses the General Electric Co. has developed a line of special low-voltage generators and a method of control. The generator is wound for 60 to 75 volts, which is as high as is ever required for welding.

The automatic-control equipment gives protection to the generator without affecting other operators, whose welding circuits may be connected to the same generator. The setting of the dial-switch on the welding-panel determines the amount of resistance in series with the arc and, therefore, controls the current used. This is regulated as required by the work to be done. Before starting the arc, the operator sets the dial-switch for the amount of current required for the work, so that on starting, the circuits are in normal running position. Thus it is not necessary to have any relays or switches open or close, or to change or disturb the electrical circuit in order to weld.

Alternating-current arc-welding equipment has been developed. A single-phase transformer is used, and is provided with taps and connections for obtaining the various values of current and proper voltage required by the bare metallic-electrode arc as used in welding. The equipment operates on a 60-cycle circuit and with supply voltages of 550 or less.

It is difficult to give universally applicable figures covering amperes, speed, etc., for electric-arc welding because of the effect of the conditions under which the work is done, the character of the work, and, to a large extent, the skill of the operator.

Approximate speeds of welding sheet-metal with the metallic electrode are given in the following table:

Thickness of plate, inches	Speed, feet per hour	Cost per foot, cents	Comparative cost per foot, acetylene welding, cents
1/16	20	2.12	1.78
1/8	16	3.12	4.66
1/4	10	7.13	13.1
3/8	6.5	12.3	36.1
1/2	4.3	19.8	Much higher
3/4	2.0	41.7	Much higher
1	1.4	61.3	Much higher

The above are based on average figures for materials and labor. They will probably vary considerably for different localities and will vary slightly with the type of equipment, but the relative costs of gas and electric welding will in general hold true.

The carbon electrode can be used frequently for welding and for building-up metal where the metal is not subjected to high strains or where it is under compression only. It can be used also for rough cutting of plates and structures.

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The following figures for metallic-electrode welding are based on favorable working conditions and a skilled operator. However they are approximations only and are given merely as a general guide.

	Amperes
Light work	25 to 125
Heavy work	up to 225

Electrode-diameter, inches	Amperes	Corresponding plate-thickness, inches
1/16	25– 50	Up to 3/16
3/32	50– 90	Up to 1/4
1/8	80–150	1/8 to 3/8
5/32	125–200	1/4 up
3/16	175–225	3/8 up

The same size of electrode may be used with various thicknesses of plate. The heavier plate will require the use of the heavier currents.

The average current-ranges for different types of work are as follows:

	Amperes
Light welding	150 to 250
Medium welding	250 to 350
Heavy welding and medium cutting	400 to 600
Very heavy welding and heavy cutting	600 to 1000

The maximum values of current permissible for carbon electrodes are as follows:

Diameter of electrode	Maximum amperes
1/4 in.	100
1/2 in.	300
3/4 in.	500
1 in.	1000

Graphite electrodes permit the use of somewhat higher current-densities but the higher cost of graphite electrodes is a serious handicap to their use. Lower currents than the above may be used, but higher values will cause undue burning of the electrode.

For depositing or building-up metal by means of the carbon arc on flat surfaces where the work is accessible and all conditions favorable, the following figures apply:

Current, amperes	Pounds per hour	Cubic inches per hour
200	1 1/2	5.4
300	3	10.8
400	4 1/2	16.2
500	6	21.6

For continuous work the above figures apply, but, for short jobs of ten minutes or less, the rate will be double the above.

Welding wrought iron and steel in simple sections by the electric-arc welding process presents no serious difficulties. Reasonable care on the part of the operator in keeping the weld clean and in the preparation of the weld will, with ordinary skill in welding, produce a successful weld. The subject of welding may be divided into three parts, namely, equipment and materials, preparation of weld, and welding.

In addition to the regular equipment and auxiliary apparatus, special jobs make it desirable to have on hand other miscellaneous pieces of equipment. Odd pieces of carbon-block or of copper may be used as dams in holding the molten metal in place. If the weld must be smooth on one side, a piece of copper or carbon may be held against the weld and metal filled against it. Iron or steel can be used if care is taken not to weld to it. When a hole is being filled the bottom may be closed by holding a plate of carbon or copper against it until sufficient metal is filled-in to hold. Care should be taken to flow the molten metal against the guide-pieces and not to allow the arc to play directly on them. Otherwise the weld will probably be contaminated by this material, or else the guide-piece may be welded solid and cannot be easily removed.

A steel-wire scratch-brush is useful for removing light scale and rust if necessary, before commencing to weld, and also at intervals during the welding, usually when changing electrodes.

For small work, the positive lead may be bolted to an iron plate forming the top of a work-bench. The work may be set on this bench, the contact being sufficient to carry the current. A vise mounted on the table will often be found desirable. If the work is too large for the table it may be set beside the table and a bar laid across to it. This will provide sufficient current-carrying capacity, provided scale and rust do not prevent contact entirely. The rails in a round-house if bonded are usually connected to the positive lead, and any car on these tracks may be welded by running only the cable leading to the electrode, the return-cable being unnecessary since the current will be carried back through the rails.

A convenient terminal for the positive cable consists of a copper hook of proper size to which the cable is bolted. The terminal may be laid on the work or hooked on a projecting part. It is seldom necessary actually to clamp the return lead to the work unless the metal is covered thickly with scale or dirt, which acts as insulation. Even here it is easier to chip or brush off a clean place for the contact than to use a clamp.

If welding is to be done in a room where other employees are doing other work, screens should be provided around the welding operator. They should be high enough to prevent the light striking much of the ceiling since the flicker of this light would probably affect the other workmen. The effect while probably not injurious, would be irritating. White walls and ceiling should be avoided in a welding-room.

Gas-burners for pre-heating and firebrick, sand, or sheet-asbestos for covering, are useful, especially for cast-iron work, which in many cases should be pre-heated uniformly to a red heat and welded while at this temperature. A receptacle for water is desirable, in which the electrode-holder can be cooled when continued use makes it too hot.

Some operators feel that gloves are necessary to protect the hands from the arc. Other operators, however, find gloves to be in the way, especially when working with the metallic electrode. If desired, however, any leather or cloth glove will give sufficient protection to the skin of the hands, which is much less sensitive than the skin on other parts of the body. The arms, neck, and face should, however, be covered, since exposure of these parts will probably cause burns similar to sunburn. These burns, while painful, are not serious.

It is the experience of a great majority of welders that flux of any kind is unnecessary, and further that it is a source of danger because it is likely to contaminate the weld. If the work is kept clean by brushing at frequent intervals, and ordinary care is taken in the operation of

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the arc, a good weld can be made without flux. If these precautions are neglected, flux will not make a good weld.

Cleanliness is a requisite for making a good strong weld. Scale, rust, grease, soot, and foreign matter will contaminate the weld and such inclusions necessarily weaken it or else make it hard. Impurities may also make the metal porous and spongy because of liberation of gas. Pieces of foreign matter may prevent the molten metal filling all parts of the weld and may cause cavities. Various methods for cleaning are in use, among them being pickling for small parts, washing with gasoline or lye, boiling with lye, sand blasting, chiseling, and scratch-brushing, the method depending on the local conditions.

Preparatory to welding locomotive-tubes to the sheets, it is sometimes advantageous to send the locomotive out on a run in order to burn off the grease and then to clean off the oxide and soot by sand-blasting. Another method is to heat the boiler to normal by steam-pressure and then clean by sand-blasting or scratch-brushing.

In welding heavy sections where it is necessary to deposit several layers of metal, the surface of the preceding layer should always be cleaned before starting the next.

When sections $\frac{1}{2}$ in. or less thick are to be joined, the edges need not be beveled but they should be separated a small amount. Thicker sections besides being separated by $\frac{1}{8}$ in. should have the edges beveled to give a total angle of 60°. In some special cases angles as low as 30° or as high as 90° may be necessary, but an average safe value is 60°. Still heavier sections may be beveled from both sides and the weld made from both sides. In the latter case a layer should be put on one side and then a layer on the other to prevent warping. For long seams the edges should be $\frac{1}{4}$ in. apart at the end where the weld is started, and at the far end the space should be $\frac{1}{8}$ in. plus $1\frac{1}{2}\%$ of the length. This takes care of the expansion of the metal in the sheet and also of the contraction of the metal in the weld as it cools. Another method of reducing expansion is to put in short sections at intervals, welding one layer at a time, starting at the centre and working alternately toward either end. Then put one layer in the open sections, and continue in the same way till the weld is completed. The welded section of any layer should not match those in the layer below or above, the joints being broken as in laying brick work.

The welding of complicated shapes such as fly-wheels and some castings may require pre-heating at certain points to produce initial expansion, which will be overcome as the weld cools. In some cases, the entire piece must be pre-heated and, in some cases, after welding the whole piece must be annealed. This is sometimes done by heating the piece uniformly, then covering it with sand-asbestos, and allowing it to cool slowly.

In welding cracks in plates, forgings, or castings, the crack should be chiseled out to get a good bevel. This chiseling should extend entirely through the plate with $\frac{1}{8}$ to $\frac{3}{16}$ in. clear opening on the back or to the bottom of the crack in castings or forgings. Sometimes in boiler work, $\frac{1}{2}$-in. holes are drilled well beyond the ends of the crack and the crack chiseled, beveled, and welded.

In welding with the metallic electrode the arc should be kept short, not over $\frac{1}{8}$ in. long. The current should not be greater than that recommended for the given electrode diameter. Excessive current causes burnt or porous metal to be deposited. The arc should be kept constant in length to ensure uniformity in the metal deposited. In welding a seam, the electrode should be moved in a zigzag or circular path advancing along the seam. The metal will adhere only to the surface on the work actually played on by the arc, so care must be used to bring the arc in contact with the whole surface to be welded.

The electrode must be connected to the negative terminal. If the polarity is reversed, the arc will be more difficult to maintain and the deposited metal will not be as good as it should be. In starting the arc, the electrode should be just touched to the work and withdrawn immediately to the required distance. If the electrode is held too long in contact, it will weld to the work causing some delay in freeing it and starting again.

The operation of welding overhead is the same as in normal welding. The difficulty lies largely in holding the electrode steady in the cramped position usually required. If the arc-length is kept constantly short the metal will be successfully deposited. The appearance of an overhead weld is sometimes marred by projecting drops of metal or by uneven thickness of the deposited metal, but this can be overcome by proper manipulation of the electrode. A rest for the arm will sometimes assist the operator to hold the electrode steady.

When using the carbon electrode the holder should grip the electrode from 4 to 5 in. from the end. For ordinary work the electrode should be tapered to a blunt point at the working-end to keep the arc from wandering over the end of the electrode. As the electrode burns away with use, the holder is moved back along the electrode to keep the length of working carbon constant. The burning away of the electrode will tend to keep the taper approximately constant.

The arc is struck in the same manner as with the metallic electrode, but a longer arc should be used. From 1 to $1\frac{1}{2}$ in. is the average. The arc should not be too short when welding or depositing metal as there is danger of depositing carbon and probably causing a hard weld. In cutting or in melting off metal, the arc should be kept short, about $\frac{1}{2}$ in. being an average length.

To cut metal (for which purpose the carbon electrode must be used) the arc is operated like a gas-torch. It is held in one place long enough to fuse the metal and allow it to run off. For thin plates laid flat, a hole is melted by holding the arc on one spot, then the electrode is slowly advanced along the desired line, the molten metal dropping out below. For thick pieces, such as shafts and castings, it is desirable to start at the top on one edge and work down, allowing the molten metal to run down through the cut. It is often necessary to follow the molten metal with the arc to keep it melted until it runs off.

The width of the cut will depend on the size of the electrode used and on the skill of the operator in keeping to a straight line. The cut must be slightly wider than the diameter of the electrode in order to allow the arc to be

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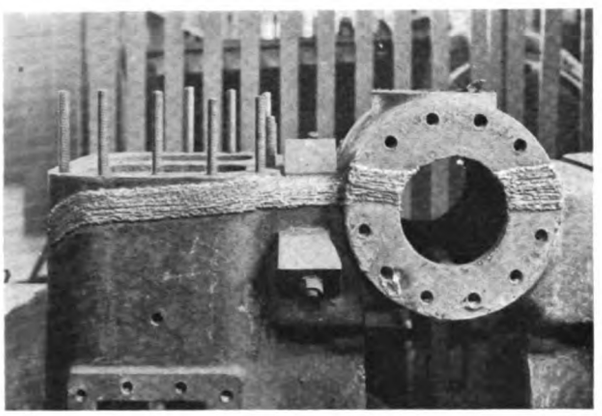
played on the bottom of the cut. The cut will be wider for thick sections than for thin ones. The edges of the cut will not be smooth, because some of the molten metal will not run away and also because the arc will tend to jump from one point to another and cause an uneven cut.

To deposit metal with the carbon electrode, the arc is struck as above, but is not held in one place long enough to melt through. A pool of molten metal is established and a melting rod of metal is fed into the arc and melted on the work. It should all be heated thoroughly to ensure a complete union before more metal is added.

Since heavier current can be used with the carbon electrode than with the metallic, faster work can be done in depositing metal. The quality of the weld is not quite so



CRACKS IN CAST-IRON PUMP FILLED WITH MATERIAL DEPOSITED BY ELECTRIC WELDING

good as when the metallic electrode is used. However, for filling holes in castings, building up worn spots, etc., the carbon weld is satisfactory and should be used. Because of the high temperature and large amounts of heat liberated when using the carbon electrode, the electrode-holder is likely to become hot and under some conditions to melt at the end. When the holder begins to get hot, it should be plunged in a receptacle of water kept conveniently near the operator.

Cast-iron, because of its properties, is unsatisfactory for welding by any method. Its low strength and brittleness cause it to break from expansion and contraction strains unless precautions are taken, and even then a successful weld cannot be ensured. Pieces of simple cross-section and heavy pieces present much less difficulty than complicated shapes, but because of the undependable nature of cast-iron, care is required in all cases. The experience and skill of the operator are large factors in determining whether or not a given weld will be successful.

CAPITALIZATION of German shipbuilding companies has increased since 1914 from 83,300,000 to 163,600,000 marks. Of this increase, 50,300,000 marks was for new construction and 30,000,000 marks for increase of capital of existing companies. The number of companies increased from 18 to 30, 8 of the new companies being formed in 1918.

Some New Aluminum Alloys

A PAPER on 'Alloys of Aluminum, and Magnesium with Copper, with Nickel, and with Manganese', by P. D. Merica, R. G. Waltenberg, and A. N. Finn is to be presented at the September meeting of the American Institute of Mining and Metallurgical Engineers. Alloys as described above were prepared and their mechanical properties and resistance to corrosion determined.

Of the aluminum-magnesium-manganese alloys, one containing 96.86% aluminum, 1.44% magnesium, 0.93% manganese, and small amounts of copper, iron, and silicon gave the best results in the mechanical tests, namely, tensile strength, 45,000 lb. per sq. in., scleroscope hardness, 36.5; elongation, 3.5%. Upon annealing at 422°C., the figures were: tensile strength, 33,100 lb.; hardness, 14; and elongation, 13%. Upon quenching at 500°C., the figures were: tensile strength, 34,100 lb.; hardness, 15.5; and elongation, 10%. An alloy containing 95.08% aluminum, 2.03% magnesium, and 1.68% manganese, with small amounts of copper, iron, and silicon, while it did not show quite as good mechanical qualities as the alloy described above, nevertheless, gave the best resistance to corrosion from salt water of any alloys of this series.

Of the aluminum-magnesium-copper alloys, one containing 95.51% aluminum, 1.26% magnesium, and 2.58% copper, with small amounts of iron, manganese, and silicon had the best mechanical qualities, having a tensile strength of 56,700 lb., hardness 50, and elongation 2%. When annealed at 422°C. the figures were: tensile strength, 34,900 lb.; hardness, 15.5; and elongation, 20.5%. Quenched from 510°C. the figures were: tensile strength of 56,700 lb., hardness, 50, and elongation, 2%. This alloy when quenched showed the best resistance to corrosion of any of this series, although without heat treatment, its resistance to corrosion was low.

Of the aluminum-magnesium-nickel alloys, one composed of 95.41% aluminum, 2.86% magnesium, 1.08% nickel, and small amounts of iron, silicon, and manganese had the best mechanical qualities, having a tensile strength of 42,000 lb.; hardness, 32; and elongation, 3%. Annealed at 500°C., the figures were: tensile strength, 28,900 lb., and hardness, 13. Quenched at 500°C. the figures were: tensile strength, 32,200 lb.; hardness, 14; and elongation, 18%. Alloys of this series did not show as much resistance to corrosion as the other alloys.

The alloys of the aluminum-magnesium-manganese series resisted corrosion, in general, better than those of the other series, and this agrees with other experience in the corrosion of such alloys. The heat-treated specimens of the aluminum-magnesium-copper series, however, were but little inferior to those of the manganese series in their resistance to corrosion; the annealed and the cold-rolled samples of that series were the least resistant to corrosion of any of the alloys tested. Hard-rolled commercial aluminum corroded much more than any of the alloys.

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Pyrometers and Steel-Treaters*

By T. G. SELLECK

ALL modern steel-treaters appreciate the value of thermo-electric pyrometers as a means of determining high temperatures, and they are in use so generally that it is a rare experience to find a steel-treating plant that is not so equipped. The value of pyrometers depends, however, entirely upon the intelligence displayed in their use, and the care with which they are kept standardized and calibrated. In the hands of ignorant operators they are as likely to lose their value as a full-jeweled solid-gold watch would be in the hands of a chimpanzee, and to become an expensive nuisance rather than a valuable help. Yet it is not uncommon to find them being used by men that call themselves 'steel-treaters' but who have no knowledge of the principles of construction and operation of pyrometers or of the care required to keep them in working order.

The fault lies, of course, with the employer. No employee should be trusted to use a pyrometer until he has been given some information concerning its construction, its principle of operation, and its delicacy of adjustment, as well as its limitations of accuracy; and, unless he has the mental capacity to grasp these things, the instrument might better be kept away from him.

The full value of a pyrometer is obtained only in the hands of an operator whose knowledge of steel-treating includes a conception of temperature as indicated by color-tints. This is essential, because the pyrometer gives the temperature of only a small area within the furnace and the true temperature of a heating-chamber can be judged only by comparing that area with the remainder of the chamber on the basis of the colors shown. It is not unusual to find men using pyrometers to whom 'heat by color' means nothing.

To such men the pyrometer is a sort of wonder-instrument that tells the whole story of temperature and 'don't even have to be wound up.' Here is a case in point:

Not long ago I was called to a certain plant where some case-hardening had been done that was not satisfactory, and the owners wished to know the cause of their trouble. The parts carbonized were discs about four inches in diameter and ¼ in. thick. Upon examining them, I found that they had been carbonized entirely through and were badly fused on the edges. The operator that had done the work informed me he had carried a temperature of 1600° for 5½ hours.

I asked if he was sure of his temperature, and he said yes, because his 'byrometer' registered just 1600°.

I suggested that there must be something wrong with his 'byrometer', since it would be impossible to fuse 20-point carbon-steel at 1600°F. and quite as impossible to carbonize the pieces to the saturation-point in that period of time at such a temperature, to which he replied: "Well, maybe it does need fixing, but I have used it several years, and ain't had no trouble before."

I prevailed upon him to have his outfit checked and learned later that the temperature carried was high enough to fuse a hole through the top of the plate-steel box used to pack the parts, and also that, while the instrument was in good condition, the thermo-couple had been broken near the hot-junction and that the elements had been twisted together and used without being welded.

In such a case, which is not unusual, the man is in as great need of being checked and calibrated as the instrument, and a superintendent who would trust results in a steel-treating department to a man so lacking in the simpler essentials of steel-treating, namely, common sense and watchfulness, should also be sent out to be 'fixed'.

In another plant where trouble developed, conditions of another nature were found. Here, the men on the job were 'highly intelligent'. The works-manager was a college graduate, well versed in metallurgy, and his steel-treater, a man of more than ordinary intelligence and some years of experience. The cause of complaint was a lack of uniformity of hardness after parts had been carbonized and heat-treated. That is, there was a variation of 10 points scleroscope when the parts had been given uniform heat treatment, where the allowable variation was only three points (from 77 to 80). Investigating their methods of carbonizing, it was a wonder that the variations did not exceed 10 points. The carbonizing-boxes were packed in the regular way, placed in a cold furnace, and the temperature raised as rapidly as possible to 1800°. The thermo-couple, unprotected, was placed in the furnace through a top-vent about the centre of the heating-chamber. The furnace temperature was maintained at 1800° for "three or four hours," the fire shut off, and the boxes allowed to cool with the furnace. With technical knowledge and years of experience in the work, these men use the pyrometer with but little more judgment than the poor ignorant fellow whose 'byrometer' had been such a faithful friend to him for so many years, that he had no idea the little matter of a broken couple could make any difference.

In one spot of the furnace they probably had 1800°, and that was the very hottest spot in the furnace, while other parts of the heating-chamber probably varied in temperature much more than the product varied in scleroscope hardness. Working within narrow limits of hardness and tempting fate with reckless heating, indicates the need of 'calibration to the job' for even intelligent experienced men.

*Abstract from 'Journal' of the American Steel Treaters Society.

Any man who thinks he is overworked in eight hours a day does not deserve to have a job. His gray matter is all one-sided.

Have you heard of that new Eastern foundry specialty called the 'Riser Whistle', which saves the foreman from yelling "Feeding iron"?

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Oxy-Acetylene Welding of Large Cylinders

By L. M. MALCHER

One of the big steel-rolling mill engines at the Farrell works of the Carnegie Steel Co., at Farrell, Pennsylvania, that had been doing its full share in helping to win the War broke down two weeks after the signing of the Armistice, having worked constantly up to then on 100% war orders. In the accident, besides other parts, the left-hand low-pressure steam-cylinder, 70 in. inside diameter, of an Allis-Chalmers twin-tandem compound-reversing engine was badly fractured, in consequence of the breaking of a connecting rod at the moment of reversal.

A serious situation confronted the officials of the Carnegie Steel Co., as it would have taken at least three to three and a half months to obtain a new cylinder, in case the broken one could not be repaired in a shorter time; 360 men were thrown out of employment. The broken cylinder was of such size and the damage done was of such character that a decision whether the cylinder was to be renewed or repaired involved a risk on the part of the management. Although considerations of expense as between the cost of purchasing a new cylinder and repairing the old one were of secondary importance, the cost of repairing was estimated to be about one-third that of a new cylinder. The time element was, however, the important consideration.

The officials of the company, after careful investigation, decided in favor of oxy-acetylene welding. They called upon the job-welding shop of the Oxweld Acetylene Co., at Chicago, to meet the emergency. Three expert welders, accompanied by all the necessary equipment, went immediately to Farrell and completed the job under my direction. The total time consumed in repairing the low-pressure cylinder, including chipping, pre-heating, and welding, was 72 hours. While dismantling the engine, a fracture was discovered in the right-hand, 42 in. diam., high-pressure cylinder. This fracture also was repaired in about 18 hours. It took just seven days, from the time the order was given to complete the entire job and have the engine ready to resume work.

The data covering this work are given in detail below:

Low-Pressure Steam-Cylinder

5000 hp. Allis-Chalmers twin-compound reversing engine. The horsepower given is the maximum developed while rolling and running at about 100 to 110 r.p.m.

Cylinder bore	5 ft. 10 in.
Stroke	4 ft. 6 in.
Weight of cylinder	13 tons
Thickness of iron casting	2¾ to 3⅜ in.
Number of cracks (See Fig. 1)	7
Total length of all cracks	22 ft. 2 in.
Preparing and pre-heating casting	27 hours
Welding casting	45 hours
Linde oxygen consumed	2850 cu. ft.
Prest-O-Lite acetylene consumed	2845 cu. ft.
Oxweld cast-iron welding-rods	390 lb.
Oxweld 'Ferro' flux	25 lb.
Number of welders	3
Period of welding shifts	10 and 30 min.

High-Pressure Steam-Cylinder

5000 hp. Allis-Chalmers twin-compound reversing engine.

Cylinder bore	3 ft. 6 in.
Stroke	4 ft. 6 in.
Weight of cylinder	5 tons
Thickness of iron casting	3½ to 6 in.
Piece of flange broken off (See Fig. 5)	
Total length of weld	4 ft. 6 in.
Preparing and pre-heating casting	9½ hours
Welding casting	8½ hours
Linde oxygen consumed	650 cu. ft.
Prest-O-Lite acetylene consumed	650 cu. ft.
Oxweld ¼ in. cast-iron welding-rods	110 lb.
Oxweld 'Ferro' flux	10 lb.
Number of welders	3
Period of welding shifts	10 and 30 min.

While welding inside the cylinder castings, the men relieved one another every 10 minutes because of the extreme heat deflected back on them during the operation. On the outside welding, however, the heat was not so intense and the men relieved one another every 30 minutes.

After the engine-cylinders were machined, it was almost impossible to determine where the cracks had been. The total cost of this repair represents but a small fraction of the replacement cost, but even this saving is insignificant when compared with the disorganization that would have resulted from the laying off of a large body of trained workmen and with the enormous loss that would have been entailed in a stoppage of production.

[See illustrations on pp. 362 and 363]

Shipbuilding at Hongkong

The 'War Sniper', the largest vessel yet constructed by the Hongkong & Whampoa Dock Co., which is the foremost shipbuilding concern in Hongkong, was launched March 27. The vessel is 412 ft. long, has a capacity of 8000 tons, and a speed of 11 knots. This is the second of a series of six vessels to be built for the Controller of Shipping in London. Steel and other materials for four of these ships came from America. The Dock company is extending its facilities and will soon have 12 berths equipped, 4 of them being for ships up to 800 ft. long.

WHILE in the South one day I happened to be in a friend's office when an old colored mammy came in for her monthly allowance from the estate of her former master. As she could not write she made her mark. Previously she had always made an X, but on this occasion she made a circle.

"Why, Linda," said my friend, "why don't you make an X as usual?"

And Linda replied earnestly: "Why, I done went and got married yesterday and I changed my name."—'The Yellow Strand'.

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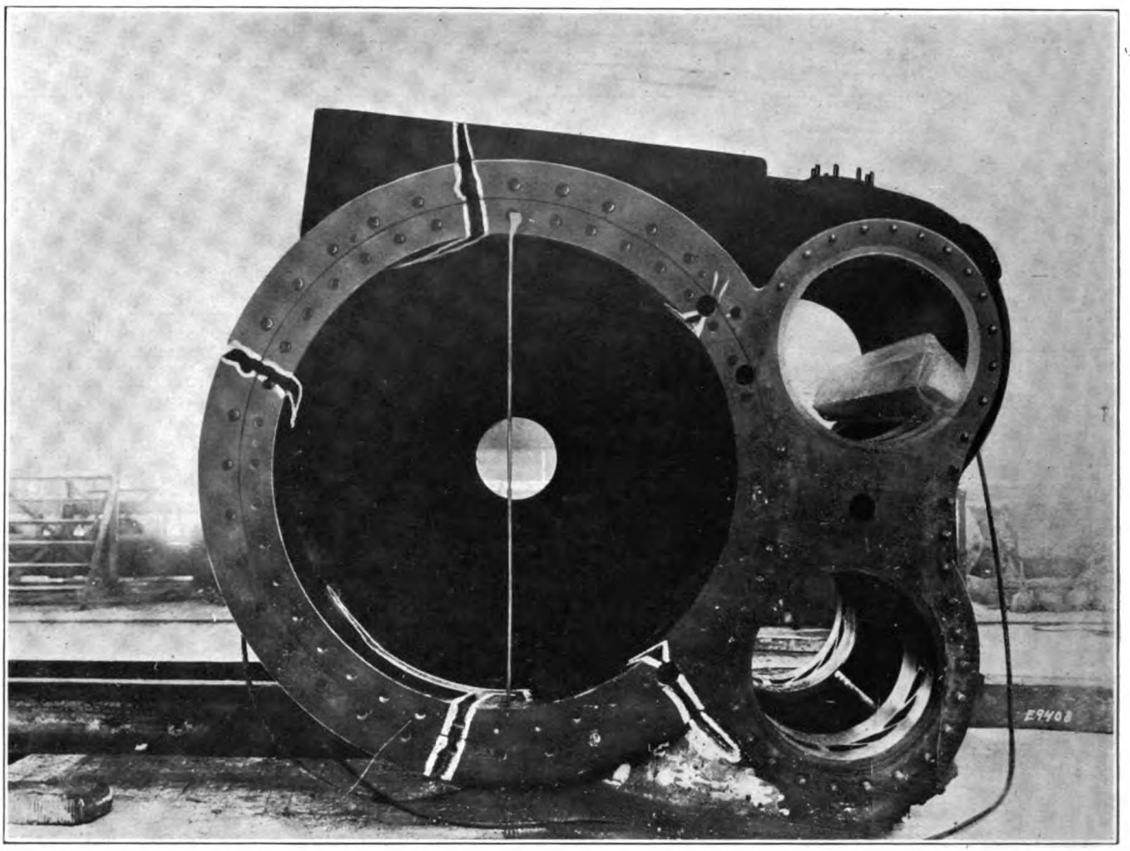

FIG. 1. WELDING WITH THE OXY-ACETYLENE FLAME: THE FRACTURED STEAM-CYLINDER

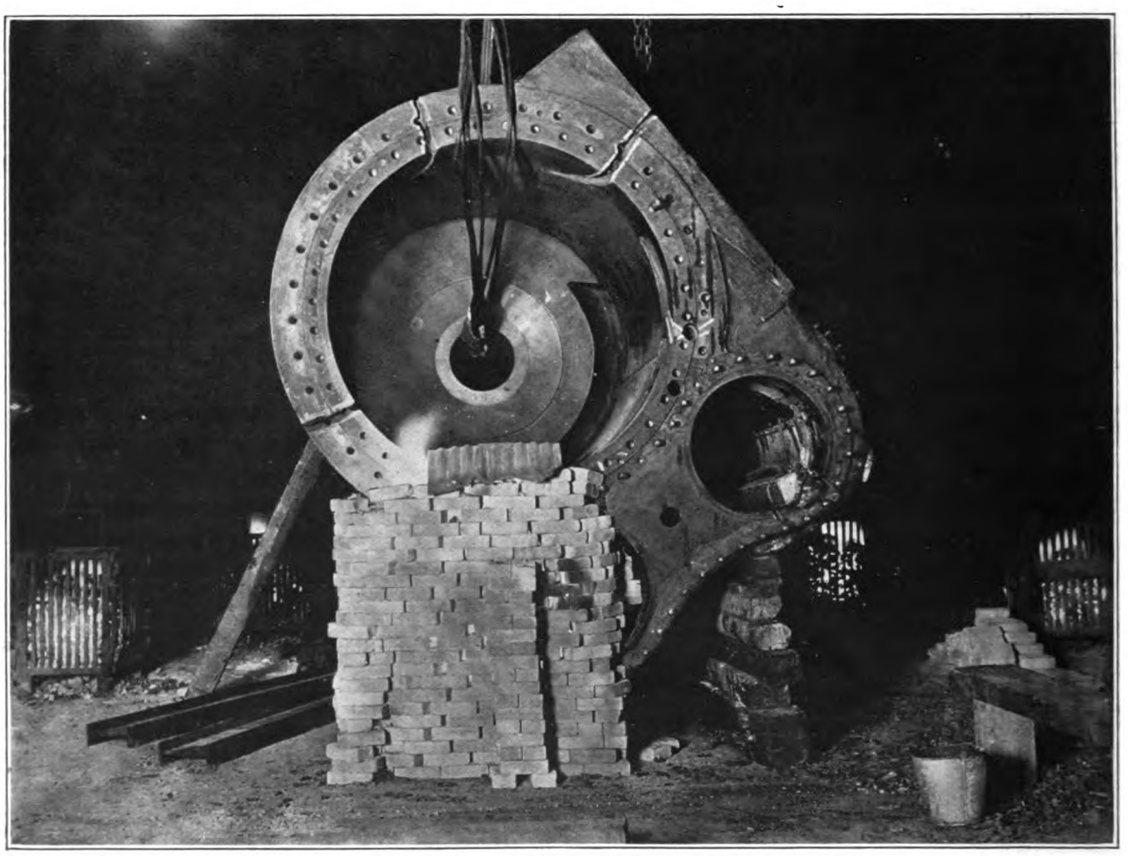

FIG. 2. THE WELDING

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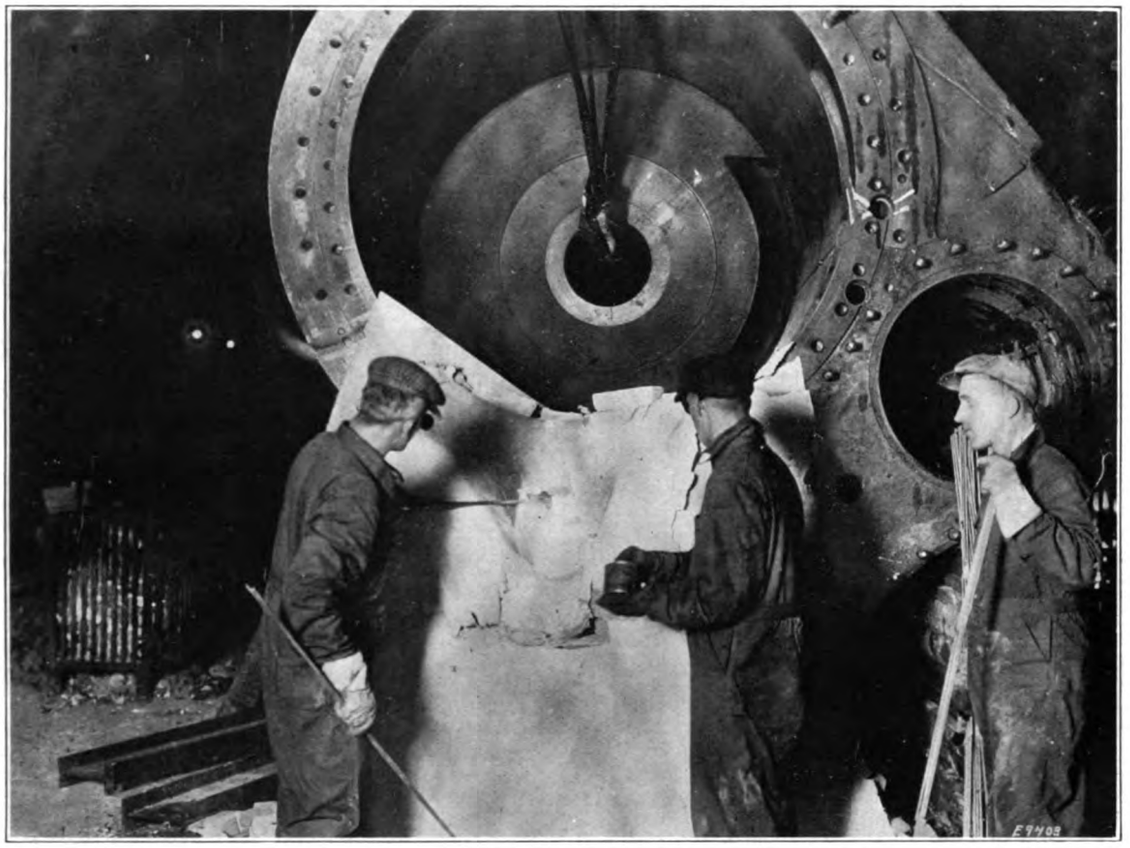

FIG. 3. A NEARER VIEW OF THE OPERATION

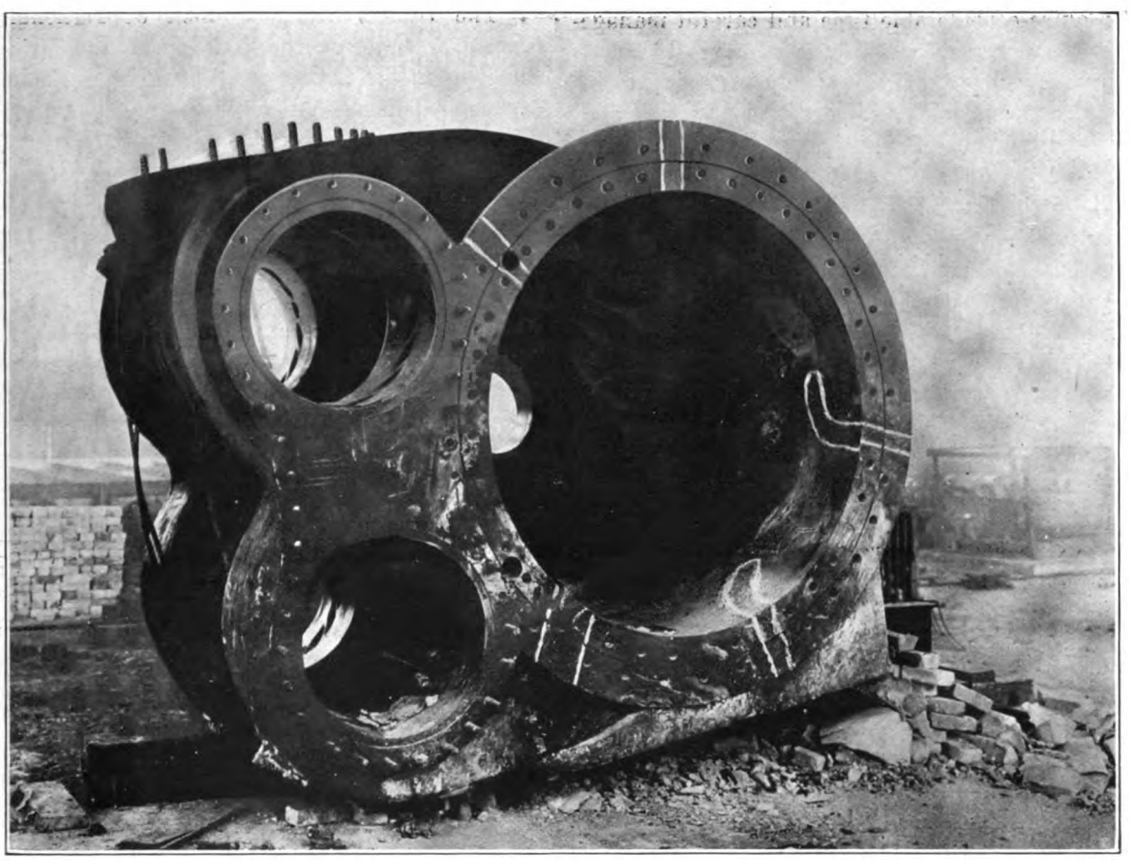

FIG. 4. THE RESULT

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Market for Industrial Machinery in Japan

By W. H. RASTALL*

AMERICAN manufacturers of industrial machinery should use foresight in developing their policies for the years 1919 and 1920. Reconstruction in Europe will provide a market for much of this machinery, but this should not be allowed to cause neglect of the Japanese market, as the demand will be large and will cover a great variety of equipment. The European war has caused a great industrial expansion in Japan. Many new factories have been established and efforts have been made to develop new industries, with the result that good profits have been secured in most instances provided it was possible to produce actively.

This expansion of industry was based largely on conditions peculiar to war times, and Japanese business men, capitalists, and officials are now making great efforts to maintain these new plants on a peace basis and also to expand in capacity or in new directions as opportunity offers. Ample capital seems to be available.

For a short time the Japanese market will be demoralized, as the Armistice seems to have been more of a surprise to Japanese business men than to those of other countries. Also excessively high freight rates have made the difference between war-time and peace-time prices much greater than in America.

It will require considerable time and careful management to dispose of present stocks of raw material without excessive loss. But even if these conditions cause a financial panic, as some prophesy, recovery should be rapid. There is a large amount of liquid capital in the country because of war profits, and it will most likely seek employment in industry, as was the case following the Russo-Japanese War.

It is true that there has been decreased activity in shipbuilding, and freight-rates have fallen greatly. Also the country is overstocked with heavy chemicals, steel, and similar goods, but the results to industry will probably not be so serious as would at first appear.

On the other hand, certain individuals hope to see Japan making all of her own steel within two years, and 114 electric furnaces are reported in operation. The textile industries will undoubtedly be expanded rapidly, and there will be a good increase in steam and water-power electric plants. In fact, Japan gives promise of early, rapid, and extensive industrial expansion, and will require a great deal of machinery of all varieties. American machinery manufacturers will meet competition, but should not exaggerate its importance.

Certain Japanese shops will try to produce the simpler types of equipment, but it is not at all certain that they can meet American prices, for although Japanese labor is paid a low rate per day the shops are so poorly equipped that the production is also low, so that in many lines the total labor charge is higher than in America.

Great Britain will undoubtedly make great efforts whenever possible. In January, English sellers of steel started canvassing the Japan market, offering plates for July delivery at attractive margins under the American prices. However, British machinery is rarely of the same type as that developed in America, and the Japanese will frequently prefer the American product, even at considerably higher prices, provided the advantages of the American article are properly presented.

Manufacturers expecting to send representatives to the Orient should allow for greatly increased traveling expenses, as hotel charges and the smaller expenses have increased rapidly and exchange is unfavorable in practically all Asiatic countries.

*U. S. Trade Commissioner.

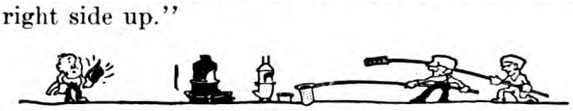
Employers and the Service-Flag

The following statement is issued by Grosvenor B. Clarkson, director of the United States Council of National Defense:

"The War and Navy Departments having issued a citation to employers who give assurance that they will gladly take back their old employees who have served in the armed forces of the United States, it seems fitting that some symbol representing this attitude on their part should be placed upon the service-flag.

"The United States Council of National Defense, therefore, endorses the placing of the United States shield upon the red border, but no names of individuals or business firms shall appear anywhere upon the flag. Any employer who sends the required assurance to the War and Navy Departments through Colonel Arthur Woods, Chairman of the Council's Emergency Employment Committee for Soldiers and Sailors, Washington, D. C., can receive the citation, and as soon as the citation is received such employer is entitled to put the shield upon his flag.

"The shield should appear upon the service-flag in the following manner: If the service-flag hangs downward, as in a window, the shield should be at the top; if the flag flies from a mast, the shield should be placed on the border nearest the mast. In both cases, the shield shall be right side up."



THE following lists of importers, exporters, and commission-merchants in Mexico, Argentina, Brazil, and Chile can be obtained from the Bureau of Foreign and Domestic Commerce or its district or co-operative offices by referring to the file number given:

	File No
Importers, exporters, and commission-merchants, Mexico City, Mexico	9793
Importers, exporters, and commission-merchants, Buenos Aires, Argentina	9794
Importers, exporters, and commission-merchants, Brazil	9795
Importers, exporters, and commission-merchants, Chile	9796

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New Hazards in Electric-Arc Welding*

By ALFRED W. JANSEN

THE adoption of electric-arc welding in the shipbuilding industry as a substitute for riveting has presented new dangers to workmen, which, under some conditions are unusually hazardous. Care has been taken for the eye, for in recent years the dangers from this intense light have been studied by specialists and adequate protection has been given. But the harmful effects of these light rays upon the tissues of the human body has had little attention. How to protect the workman from this hazard is more easily solved when the cause of the intensity of the light ray is known under all conditions.

The complete spectrum usually presented in the process of electric-arc welding is composed of the visible, the ultra-violet, and the infra-red rays. The ultra-violet and the infra-red, the invisible rays, are those harmful to the exposed tissues of the body. The intensity of the invisible rays is determined by the temperature of the arc and by the surroundings, which may either reflect or absorb the light. While it has been known that painful body-burns have followed exposure to these extreme light rays, it has not been determined whether they are caused by the ultra-violet or the rays in that point of the spectrum where the X-ray is found. The infra-red rays are not the cause, for while they have an irritating effect and are rather uncomfortable and fatiguing, they are not especially dangerous.

There are no great hazards in arc welding done in the open, in shops, or in places where special screens may be erected to protect the welder and those near by. They have not been serious in confined places such as boilers, where the surroundings have absorbed some of the intensity of the light and not reflected it. But on board ship, in compartments where the working space is hardly large enough for two men to be employed at the same time, and where the entire surroundings have been covered with red lead, the dangers of the light rays seem to be greatly increased.

Not long ago, electric-arc welding was used aboard a large steel ship under construction, in a compartment as described above. The welder had worked with the same apparatus for some time under ordinary conditions and had not experienced any burns on the exposed parts of his body. Within a few hours the man complained of burns on his neck and chest. A close examination of the skin showed it to be dried up and cracked, like an old piece of china, on which the glazing has become crazed. Added to this the skin was slightly inflamed and was deeper in color on the right side of the neck. Here there was a spot about the size of an egg which seemed to have been subjected to more exposure than other parts of the body. There was a little tinge of blue on the inflamed spot which looked like a burn caused by the X-ray. It was decided that this was due to the improper adjustment of the face-mask, which caused constant exposure to the direct rays. The burns on the back of the neck were apparently caused by the intensified rays reflected from the red lead.

After four days the burned condition healed sufficiently to permit further experiments to determine the cause of this unusual condition. The welder was supplied with a linen bandage lined with lead foil, which he wore as a collar to protect the entire neck. As ultra-violet rays will not pass through lead, and as no further burns appeared, it was decided that the ultra-violet rays were the cause of the trouble. As the welder had worked with the same apparatus under other surroundings, it was concluded that the reflected rays from the surfaces painted with red lead were increasing the power of the harmful rays to such a degree as to cause painful burns. Such severe burns might even lead to cancer.

The next experiment was made by welding in a compartment that had not been red-leaded, and where the surfaces were of the natural metal color. The hazard in this case was very much reduced. As no special apparatus was available for measuring the intensity of the rays in the read-leaded compartment, it is not known whether the ultra-violet rays had reached that point in the spectrum scale where the X-ray is found. It seems, however, that the red lead had either the effect of absorbing the infra-red rays, and thereby intensifying the ultra-violet, or the red lead converted the infra-red to ultra-violet rays.

As in shipbuilding these working conditions in a compartment are common, and as the burns are so intense, a necessary precaution is to have all of the welding done before the surrounding surfaces are red-leaded. This is the surest way of giving the workman maximum protection.

*Abstract from 'Safety'.

"REMEMBER, CONSTABLE," said the portly Mayor to the policeman who stood on duty at the town hall on the night of the children's fancy-dress ball, "no adults can be admitted."

"Right, Yer Mayorship," said Dooly as he set about regulating the crowd.

Everything was in full swing when Dooly felt himself clutched by an excited-looking woman. "My little girl is in there," she said, pointing to the ballroom, "and she's forgotten part of her costume."

"Can't help it, ma'am, no adults is to go in."

"Nonsense," cried the woman. "My little girl has gone as a butterfly, and has forgotten her wings. I want to put them on her."

Dooly wrinkled his forehead and tried to think if any of the official regulations prescribed for a case like that.

"Orders is orders, ma'am," he said at last. "Ye'll have to let your little girl go as a caterpillar."

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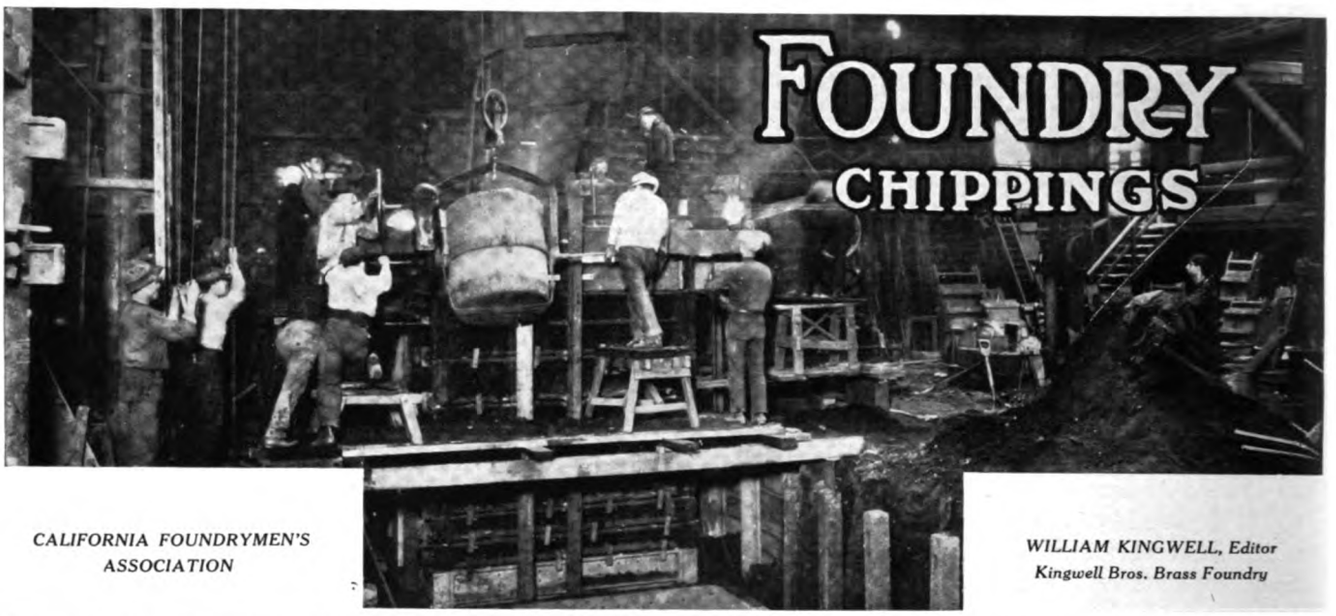

Electric Furnaces for Melting Non-Ferrous Metals—The Baily Furnace

THE Baily furnaces are of the resistance type, their heating element consisting essentially of granular carbon placed in a silicon-carbide trough, and are of the type that have for a number of years been in common use for heat-treating and annealing steel. Some of the most notable of these heat-treating furnaces have been used for treating draw-bar knuckles. During the past year such furnaces have been used for the heat treatment of Liberty aeroplane-motor crank-shafts (over half of which were so treated) and also for cast-steel anchor-chain.

The success of furnaces of this type in annealing and heat treating led to the development of furnaces of similar design with detail modifications for the melting of brass and other non-ferrous alloys. The first of these furnaces was put in commercial operation nearly three years ago at the plant of the Lumen Bearing Co., Buffalo, New York, for the melting of 'Lumen', a metal which, on account of its high zinc content, could not be commercially melted in open-flame furnaces, and, even in crucible-type furnaces, could be melted only with a relatively high zinc loss.

The principal factors to be considered in the development of a successful brass-melting furnace are the metallurgical requirements, the mechanical features, the electrical characteristics, the thermal efficiency, and the commercial economy as compared with other types of melting equipment. The obvious advantages to be found in an ideal electric furnace over fuel-fired types for melting are first, the elimination of crucibles, which account for a large part of the cost of melting brass in pit-type furnaces, second, the reduction in metal loss when handling zinc mixtures, on account of the slight vacuum under which all pit-type furnaces are required to operate, and third, the ability to maintain a reducing atmosphere in the furnace at all times, which is impossible in fuel-fired furnaces when operating with any reasonable degree of fuel efficiency, since copper alloys, as well as copper, have a tendency toward the absorption of various undesirable gases when in their high molten condition, this being equally true of other non-ferrous metals such as aluminum and their alloys.

Before the development of these furnaces for brass-melting, a careful survey was made of the more common types of steel-melting electric furnaces, to determine whether such furnaces could be readily and successfully adapted for brass and other non-ferrous melting operations.

Arc furnaces have the advantages of compact form, simplicity with which the heat from the arc is imparted to the bath, high thermal efficiency obtainable with rapid melting, and the further advantage that the arc-furnace has already been highly developed for steel melting, both from a mechanical and from an electrical standpoint.

Observation of the induction-type furnace for melting steel, as it might be applied to the non-ferrous industry, indicated the high economy with which these furnaces could be operated, even as compared with arc-furnaces, the simplicity of the electrical principles involved, so far as they applied to the mechanical apparatus, and the ability to keep the furnaces substantially closed.

The objectionable features of the arc-type furnaces taken into consideration were, in the first place, the mechanical considerations, including the necessity of hav-

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ing movable electrodes, requiring constant adjustment; the difficulty of keeping the furnace tightly closed at the point where the electrodes entered and at the same time preventing them from sticking at this point; and from a metallurgical standpoint, especially important when considering the melting of metals containing zinc, the undesirable effect of the highly localized temperature produced by the arc.

The arc-type furnaces for melting brass are also open

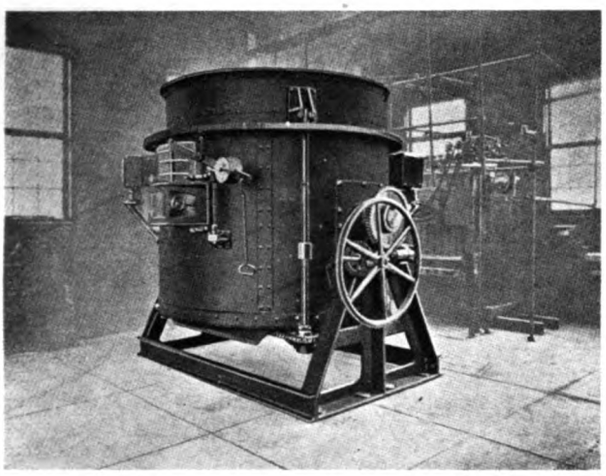

FIG. 1. 105-KILOWATT TILTING TYPE FURNACE

to the same objection met in steel-furnace practice with regard to refractories. The accepted practice in the steel industry, in order to minimize this difficulty, is to use electrodes of relatively large section placed with their axes vertical to the level of the bath, so as to have the arc itself 'hooded' to as great an extent as possible by the electrodes themselves.

From an electrical standpoint, the accepted type of steel-melting furnace, when supplied with automatically operated electrodes, is able to give fair power characteristics, both as to power-factor and load-factor, especially furnaces of the three-phase type, although this favorable condition is not to be found in single-phase furnaces with hand-control.

An examination of the advisability of melting brass in the usual arc-type steel melting furnace showed that this type of furnace unmodified could not be successfully operated without a thick slag-bath between the metal and the arc, and while some success in brass melting has been obtained by the use of this thick slag cover, the inconvenience of operation incurred by this feature was such as to make it decidedly objectionable.

In considering the steel-melting furnace of the induction type, for brass-melting, the objectionable features were the difficulty involved in starting the furnace with cold metal; the necessity of keeping some metal in the furnace at all times and of keeping the current on; the likelihood of short-circuiting on high lead mixtures; and the narrow channels necessary in order to hold the secondary current within reasonable range, a condition which would be greatly aggravated with most non-ferrous metals because of their high electrical conductivity as compared to steel.

From an electrical standpoint, while the induction furnace has an advantage over the arc-furnace because of the absence of electrodes, on the other hand the bad power-factor seems to indicate that furnaces of this type cannot be successfully built in the larger sizes.

The following are the necessary requirements for a furnace for non-ferrous metals:

1. The metal should be contained on a true open-hearth, and the heating element should be entirely independent of the metal.

2. The heating element should be such that there will be a comparatively slight difference in temperature between this heating element and the bath, so as to overcome the objectionable features offered by the arc-type furnaces.

3. It should be feasible to close the furnace tightly in order to keep the molten metal under pressure, however

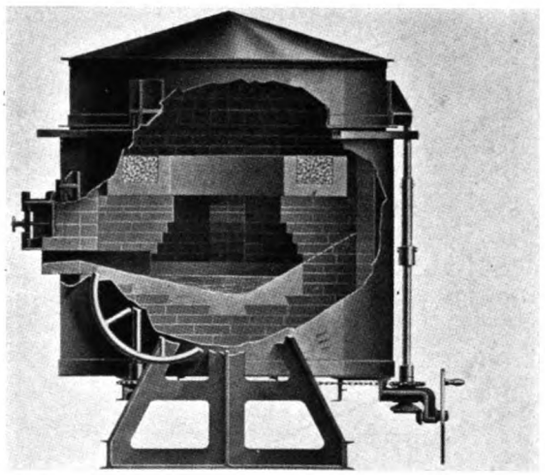

FIG. 2. SECTION SHOWING INTERIOR OF FURNACE

slight, and to prevent, as well, any draft of air through the furnace-chamber.

4. The electrical characteristics of the furnace should give a good power-factor and load-factor.

5. The furnace should be easily regulated, and the power supply steady and constant, and preferably such that any given amount of current desired can be turned-on the furnace, and that quantity maintained without further attention from the operator, in much the same manner as the turning-on of an incandescent lamp.

6. The furnace should not be subject to rapid changes in temperature from the most desirable ruling temperature for any particular melting operation.

7. The furnace should be as compact as possible, in order to reduce radiation losses to a minimum.

In this latter case, while the resistance-type furnaces about to be described require a somewhat larger shell for a given melting capacity than either the arc or reduction furnaces, the absence of the highly localized temperature does not produce such a serious condition with regard to the refractories; and the lower temperature with which

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the resistance element in a resistance-type furnace operates, permits a higher degree of heat insulation to be used, so that the thermal efficiency of resistance-type furnaces compares favorably with other types—with the exception, perhaps, of the induction furnace, whose higher thermal efficiency is offset by its higher renewal and repair cost.

One of the mechanical features considered before determining the type of furnace to be used, was whether it was necessary, in order to obtain perfect alloying, to provide some oscillating motion, such as was originally used on the Stassano steel furnace. However, substantially all copper alloys, with the exception perhaps of lead, diffuse completely when the proper temperature and melting conditions are reached, and all the agitation required is the stirring-in of the spelter previous to pouring, and this stirring is required only in order to facilitate the more rapid diffusion of the alloy.

The only materials in the Baily furnace that need regular renewal are:

1. The resistor-troughs themselves, which are made of carborundum fire-sand and water-glass, and were formerly tamped into place in the furnace with the aid of wooden forms, but are now made in sections at the factory and baked ready for placing in the furnaces.

2. The electrodes for leading the current from the cable-terminals through the furnace-walls and into the resistor-material.

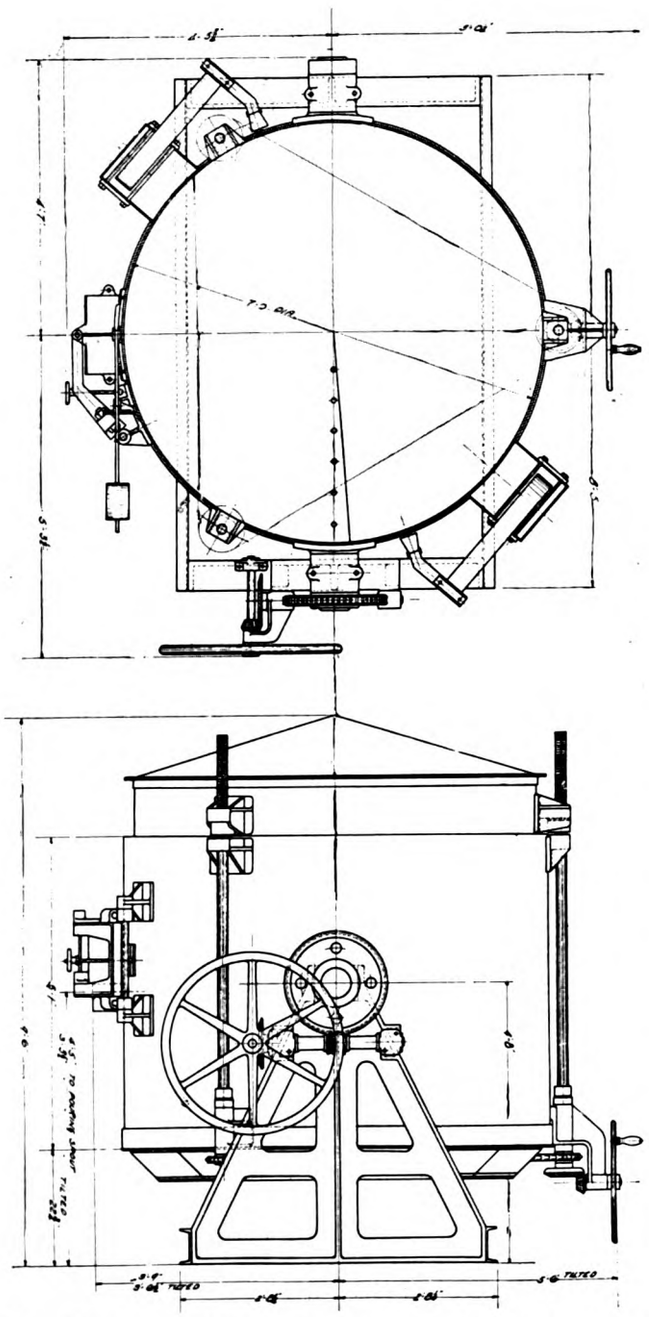

FIG. 3. PLAN AND ELEVATION OF TILTING-TYPE FURNACE

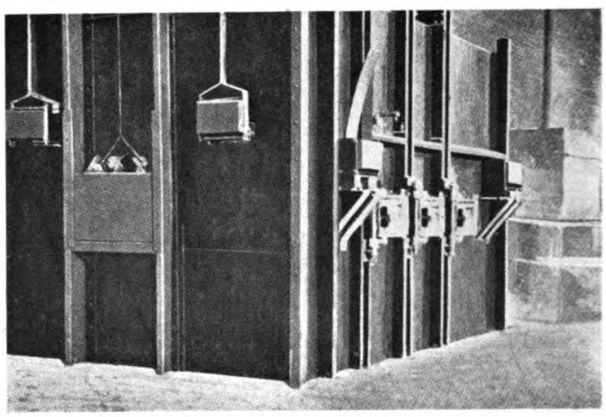

FIG. 4. 500-KILOWATT FURNACE FOR ALUMINUM

3. The resistor material itself, which consists of broken carbon crushed to about $\frac{1}{4}$-in. mesh.

Under average working conditions, the fire-sand troughs, and a pair of electrodes, will last from three to four months, while the resistor material requires additions of fresh material every two weeks. This latter is accomplished in the small tilting furnaces by raising the roof by means of three screws, which are operated simultaneously by a hand-wheel on the back of the furnace, which is operated through sprockets and mitre gearing.

The Baily furnace is built in two regular designs, the first, which has found wide application in foundries, is of the round tilting type; while the other, of rectangular shape, is the type used for melting large tonnages and for smelting operations.

The round type (shown in Fig. 1) is provided with a circular resistor-trough with the electrodes coming into the trough diametrically opposite each other, the resistor being renewed by lifting the roof. In the rectangular type, there are two straight resistor-troughs placed longitudinally along each side of the hearth. The resistor-material, in this case, is charged by means of long shovels through a door at each end of the furnace and directly above the trough. A sectional view of the round-type furnace is shown in Fig. 2. This furnace is a standard 105 kw. trunnion-type with a rated hearth-capacity of 1500 lb. and a melting-rate of 600 lb. per hour. Under favorable conditions, however, as much as two tons has

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been placed in the furnace at a time, and the melting rate has been increased to more than 1000 lb. per hour.

The furnace consists of a steel shell made of ¼-in. plate, seven feet in diameter and approximately six feet high, mounted on the usual cast-iron trunnions and brackets, and having the usual hand-wheel tilting-mechanism. The interior of the furnace is approximately 5 ft. 6 in. diam., with a wall of circular brick about 4½ in. thick. The space between this brick wall and the steel shell is filled

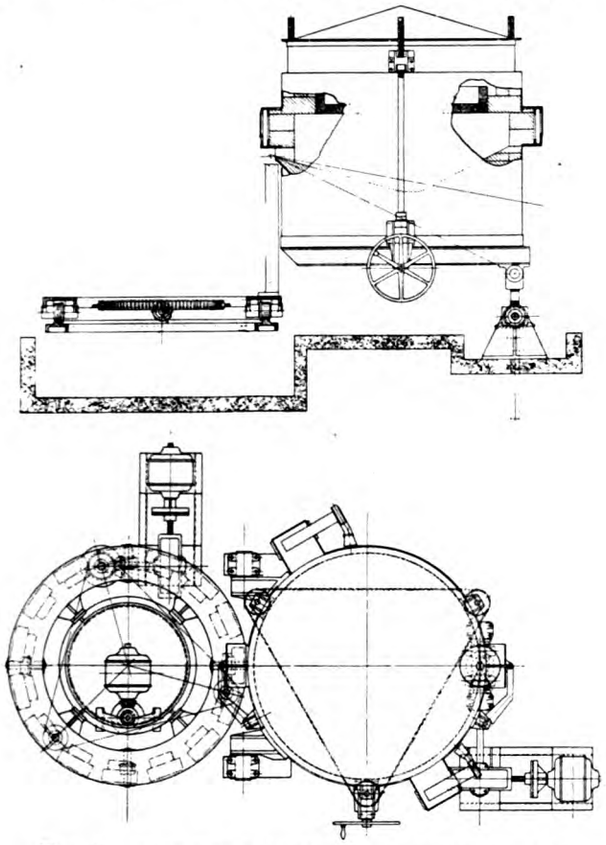

FIG. 5. NOSE-TILTING TYPE BRASS FURNACE AND CASTING-TABLE

with kieselguhr insulation. The steel roof-ring is adapted to hold securely the skew-backs of the domed arch, and is provided with a lower fin for dipping into the sand seal. The space above the trough-dome, and below the steel top is also filled with kieselguhr.

The hearth is in the bottom of the furnace, and is composed of a mixture of carborundum fire-sand and plastic clay material bonded with silicate of soda. The resistor-trough is above the bath and completely encircles the rim of the hearth line, although a considerable distance above it, and is set on firebrick piers, so that the heat from the lower part of the fire-sand trough is readily dissipated from this part of the trough within the furnace-chamber. This feature is of importance in the successful design and operation of resistance-type furnaces, as all early experiments with furnaces of this type without this feature failed.

The resistor-material contained in this trough, and into which the electricity is introduced by means of the two carbon electrodes, radiates the heat generated in it to the roof of the furnace, and thence down on the hearth; while the heat coming from the lower part of the trough, between the supporting pillars, is also radiated directly to the bath. Since this resistor-ring has a radiating surface of over 40 sq. ft. there is no highly localized temperature in this furnace.

The control of the furnace is obtained by means of impressing various voltages on the low-tension side of a special selective oil-break switch. The transformer is wound for any convenient line-voltage, while the secondary of the transformer is provided with various voltage taps, usually giving a voltage ratio of two to one on the low-tension side. By means of this arrangement, the electrical losses are reduced to a minimum, and accuracy of control obtained.

The only opening to the furnace, which is used for charging the material to be melted, has a swing-type plug-door. The pouring-spout is a groove underneath the door, which enables the molten material to be poured without opening the door, the door itself being opened only during the charging or rabbling time. A false door, consisting of a ribbed cast-iron plate, is also provided, so that when the main plug-type door is open during the charging or rabbling operations, this false door can be dropped down, shielding the operator from the direct heat of the furnace-interior.

The seven-foot furnace is also built in a nose-tilting type. This is operated by means of a motor-driven screw-mechanism at the rear of the furnace, Fig. 5. In this type of equipment the charging-door is placed at the rear, and a small spout is arranged at the front for pouring the molten metal. This type of furnace is particularly well adapted to casting rolling-mill slabs.

The casting-table is adapted for a vertical adjustment of 40 in. for taking care of molds of different heights. The turning motion is imparted by means of a motor-driven vertical pinion engaging a circular rack attached to the movable table, the molds being attached to the top of the table in the usual manner.

Of the stationary non-tilting furnaces the smaller size is of 500-kw. capacity, and is adapted to hold 10 tons of brass or 3 tons of aluminum. This furnace (shown in Fig. 4) has a resistor-trough of the usual type at each side of the bath, which is supported on the usual firebrick pillars. The doors are at each end of the furnace and are of the sand-sealed type. One of these furnaces, operating on the remelting of aluminum pig, and making aluminum copper alloy, is in use at the plant of the U. S. Aluminum Co., Massena, New York. An interesting feature of the use of furnaces of the resistance type for melting aluminum is that for a given quality of castings, a much larger proportion of scrap or re-melted metal can be used than when using iron pots or open-flame furnaces.

A larger size of this rectangular type of furnace is also made. A 1000-kw. furnace of this type is used for melting zinc cathode at the plant of the Anaconda Copper Mining Co. This furnace has a maximum hearth

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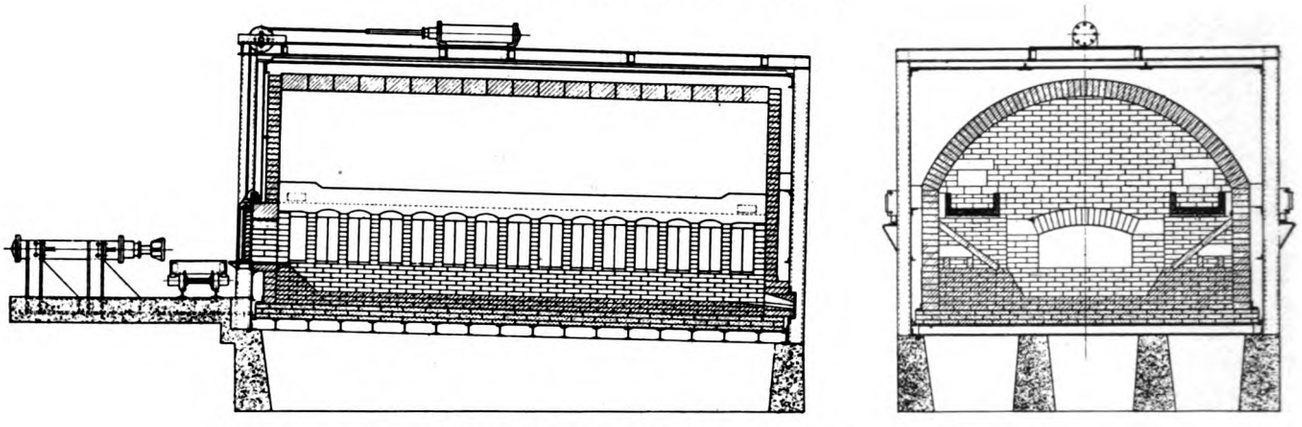
(FOUNDRY CHIPPINGS SECTION)



CONTINUOUS ZINC-MELTING FURNACE

capacity of 50 tons and a melting-rate of 200 tons per day. The metal loss in pounds per hour is substantially the same at all ordinary capacities and, as the capacity approaches the maximum rate of 200 tons, the metal loss drops to less than 1%.

The Baily furnace is adapted to the needs of the non-ferrous metal industry, not only in brass-foundries and rolling-mills, but also in melting and refining in smelters. This is particularly true of the furnace described for melting zinc cathode, which it is believed will find a wide application in the melting of cathode copper, which latter operation has been accomplished in furnaces of this type without the usual blowing and poling necessary for refining; and producing copper-wire bar or ingot of substantially the same analysis as the copper cathode, the finished bar or billet having only that amount of sulphur contained on the cathode as charged and coming from the electrolyte. Clean scrap of various kinds can be remelted without deterioration in quality.

Besides those already mentioned in this article, Baily furnaces are in operation at the following plants: Anaconda Copper Mining Co., Anaconda, Montana; Baltimore Copper Smelting Co., Baltimore; Buick Motor Car Co., Flint, Michigan; Hays Manufacturing Co., Erie, Pennsylvania; McRae Roberts Co., Detroit; Michigan Smelting & Refining Co., Detroit; Penberthy Injector Co., Detroit; Standard Sanitary Manufacturing Co., Louisville; and U. S. Navy Yard, Washington. The Pacific Coast representatives are Gunn, Carle & Co., of San Francisco.

MR. TOMKINS was obliged to stop over night at a small country hotel. He was shown to his room by the one boy the place afforded.

"I'm glad there's an escape here in case of fire," commented Mr. Tomkins as he surveyed the room; "but what's the idea of putting a prayer-book in the room in such a prominent place?"

"That," replied the boy, "is intended for use in case the fire is too far advanced for you to make your escape, sir."

A Sight for Sore Eyes

The accompanying photograph shows German prisoners at work repairing the cathedral at Rheims. Unfortunately, we cannot (as yet) show the ex-Kaiser on the job.

Guesswork in Foundries

After visiting many foundries of various capacities, making gray iron, malleable iron, and steel castings, I found:

1. Few foundrymen had any idea of the total cost (even after production, much less before) of good castings of various weight and complexity.

2. Fewer still had any correct notion of the cost of the metal at the tap-hole.

3. Some had no costing system.

4. More sold castings at a flat price, no matter whether large or small, cored or not; and were losing on many.—Grimshaw's Bulletin.

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Retrospection*

From an Article Appearing in the San Francisco 'Chronicall', 2050 A. D.

INTERESTING indeed were the exercises held yesterday afternoon at fourteen o'clock on the occasion of the demolition of the old Foundrymen's Hall erected back in the 1950's to make room for the new 75-story building now being erected on the old First and Market Street site. The particular interesting event of the ceremonies consisted in opening the old sealed cornerstone box of the first building and reading from the articles and notes placed therein about 1950. These notes are valuable only as records of the past, though we must admit that our predecessors produced some good work considering the crude apparatus and methods at their disposal, and the reading was received with much merriment; particularly among the younger members. It would perhaps be interesting to note a few details from the past and our reporter has jotted down some of the quaint sayings and ideas from the old records found in the cornerstone.

"All members are warned of the new alliance of the foundry supply men. The Snow-Schmitt-Wilson Corporation, Limited, are about to increase the price of sea-coal. They have announced that on account of the scarcity of wharf-sweepings their aeroplanes will not deliver less than ten-ton lots at a time, and at a price of $750 per ton less 90 and 10 and 6⅔ and two 5's. Their last house sales-o-graph advises us as well that they are planning to discontinue the practice of having more than two of their firm act as salesmen in the same shop at the same time, and it will readily be noted that if this pernicious threat is carried out the foremen in our shops may have to 'josh the shipping clerk' as a new pastime, which is unfortunate, as shipping clerks have become woefully scarce.

"One of our members met with a sad and costly experience last week. While peacefully returning to his office he was accosted by no less than 128 bargain-sales pig-iron agents who importuned him for orders; and he only escaped by giving each a hundred-ton order, delivery in 7 years unless called for sooner, payment spot cash or later.

"We desire to call the attention of our membership to the new law now being enacted in our Legislature. A meeting will be called for expression of opinion, but briefly it allows of price regulation by a commission. We can decide as to the price that should give a suitable profit and offer our proofs. If approved by the commission, these prices will be legalized, and it shall be unlawful to sell at a lower price than the legal allowed rate.

"On last Yom Kippur the scrap men formed another combination much stronger than the one of 1920. Their new name is the 'Three Balls Melting-Stock Co.'' and they are planning to resist the demand of the foundrymen that sash-weights shall not be considered No. 1 scrap. As foundrymen skilled in the selection of good melting-stock, we will watch with interest the advent of this new corporation and we would recommend to our members that they should not seriously object to a few sewing-machines or door-knobs in their scrap; but if delivery includes sash-weights or coal-hods, a complaint should be made to the Scrap Committee, which will classify it as No. 16; good enough for Mare Island."

The Foundrymen of these olden days had a banquet every month and passed around a few quips at the expense of the members. Among these we find:

The Macauley Foundry made a gas-engine last week for the Hockus Pokus Aeroplane Co. that held water before Smooth-on was applied.

The Enterprise Foundry poured a large casting in its No. 14 shop a few days ago, consisting of ten tons of iron and one molding brush.

The Western Foundry made a marine cylinder the other day, which is reported good enough for Los Angeles, and the customer is planning to keep it.

A Stockton foundryman was in town last week and is looking into the new process of using a small proportion of pig-iron in some of his best castings.

Our Friend Mears got in wrong with a San Jose foundryman the other day. He went into the office and instead of saying "Hello" he starts right in by saying "Ta-Ta, Ta-Ta," and the foundryman said, "Goodbye yourself. What d'ye come in for."

The Tuffli Brothers say they are from Missouri and you'll have to show them any better pig than the Carbon Hill that makes Birmingham.

Steiger & Kerr, the stove engineers of the Accidental Foundry, have perfected a hot-air stove for use in the Bakersfield district in July. At first sight, it appears to be the real article. This enterprising firm guarantees that if directions are followed the stove will last a lifetime. The fuel advised is cast-iron cupola droppings painted red.

The Union Iron Works has devised a submarine that will stay under water indefinitely.

Dave Guild of the Phoenix Iron Works reports that the building-column and base business has improved to such an extent that the building owners are now hauling them away free.

The United Iron Works has just completed plans for a new pump, which can be changed at will to pump water, milk, red bricks, or purchasing agents.

We hear from Sacramento that one of their prominent foundrymen says he quit the game because it took too much time.

K. C. Schmidt is offering a reward and no questions asked for the name of the feller that put glue in his last barrel of Partomol, and Snow says there's no use to look at him when he offers it either; because he has a

*Part of address delivered by E. J. Fowler at a banquet of the California Foundrymen's Association.

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barrel of graphite himself that he'd like to know who opened the head and put in a piece of pig-iron.

Behneman of the Joshua Hendy Iron Works says Sunnyvale is spelled with a U not an O and it's a good place to manufacture. He says they can get good cores from their apple orchard not far away.

Nate Alpers went over to Kingwell's shop the other day and said: "Kingy, old boy, if you don't stop putting copper in your castings you'll ruin the business," but Kingwell got back all right, he said, "Copper, what's that, never heard of it."

John Hedley says that loam molding is rapidly going out since the horse is being replaced by the automobile.

Our reporter feels that perhaps a discourse as to the present foundry art in 2050 compared to 1925 to 1950 might be of interest and the secretary of the California Foundrymen's Association wrote the following:

In the old days before our great aeroplane expresses, hydro transportation and our various telauto conveniences, the foundry trade was at its worst. Business men crawled over the surface of the earth in automobiles at the snail's pace of thirty miles an hour. Foundries melted their iron with coke fuel instead of the present electric furnace, they made mixtures of scrap and occasionally some pig-iron instead of the prepared melting stock now in vogue already mixed for special purposes. Their molds were of sand, having to be prepared for each casting instead of our non-destructible metal molds of today. Metals were of many kinds, not uniform, all iron, rusted, and prices were cut to pieces instead of being regulated by the State. Our Association was only a handful of members and the purchasing agent was still the bogy man held over foundrymen to keep them good. However, aside from these difficulties the foundry business was a good one.

CHEESE IT.

The Use of Steel in Cupola Mixtures

By W. J. MULCAHY*

Much has been written on the use of steel in the cupola, or in the making of semi-steel. Wonderful claims have been made as to its value, and also as to the large proportions that have been used. So often the question is asked, "What is semi-steel?" So far, to my knowledge, no general definition has been accepted. I would classify semi-steel, as it is known, as 'any gray iron mixture with any given percentage of steel added thereto.'

Then the question arises, "What benefits are derived from the use of steel in a cupola?" Steel, when properly added to gray iron, provided all ingredients are in the correct proportions, will increase the strength, produce a closer-grained metal, and reduce considerably the possibility of a porous or spongy spot at a point where a heavy and light section join. Steel should always be melted in the cupola, as any appreciable amount added to the ladle will have a tendency to chill the iron to such an extent that poor results will follow. Steel scrap should not be of too heavy a section, as steel has a higher melting point than cast-iron. It will readily be seen that steel of a heavy section will not melt as rapidly as the cast-iron scrap or pig, and the mixture produced will not be as estimated.

The amount of steel that can be used with the best results will depend on the thickness of metal to be cast and the other materials that are to be used. On light sections and with low silicon pig, much less steel should be used than when the castings to be made are of heavier sections and higher-silicon pig is being melted. From this statement it must not be construed that the silicon content is the only element to be taken into consideration when making semi-steel. In some cases 5% or 10% steel will have the desired effect, while in other cases 25% or 30% would be more desirable. Generally speaking, 25% is about the maximum amount used with the best general results. I have on several occasions used as high as 40%, although it was not through choice, but because it was necessary with the material on hand. The great danger from large proportions of steel is sluggish iron and abnormal shrinkage. For the best results, steel should be melted with a low blast, and in a cupola that has a large tuyere-area as compared to the area of the cupola.

Steel adds strength to cast-iron principally because it reduces the silicon content, reduces the phosphorus, and reduces the total carbon. It will therefore produce a metal lower in graphitic carbon and higher in combined carbon. Of course, the percentage of combined carbon will depend upon the section of metal, the pouring temperature, and the other elements. When figuring a mixture, it is safe to assume that no silicon is present in the steel scrap, providing a rolled steel is used. All rolled steel has a small amount of silicon, but after the oxidation has taken place in the cupola, so little is left that it will have no bearing on the finished result. If cast steel is used, the estimated figure to be considered should be 0.30% silicon. A fair average analysis to be used for estimating purposes would be as follows:

Rolled Steel	%	Cast Steel	%
Silicon	0.00	Silicon	0.30
Manganese	0.50	Manganese	0.50
Phosphorus	0.04	Phosphorus	0.05
Sulphur	0.05	Sulphur	0.05
Carbon	0.20	Carbon	0.25

Steel has some decided benefits in certain classes of work, principally in producing castings that have to stand a test, and where a metal of great strength is desired. Where cast-iron is being produced that must have exceptionally good machining qualities, steel has no place in the mixtures.

*Charles C. Kawin Co., chemists and metallurgists.

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The Ancient and Modern Founder or Molder*

By JOHN HEDLEY

Our wealth, commerce, and manufactures grow out of the skilled labour of men working in metals.—Cobden.

This being the case, it would appear that the molder or founder has been an important and useful factor in all that appertains to the building of mechanical devices, for the first essential of almost any machine, whether of iron, steel, or brass, is a sound casting. The molder or foundryman, however, has, to the best of my belief, never been shown in print as he really exists, except in ancient times, when he appears to have been highly esteemed. All that has come under my observation has been written by some newspaper reporter. As this is not done understandingly, it is usually a lot of bunk about the glowing metal, the grimy, sweating demons, etc., thus giving the reader a picture resembling the lower regions on a small scale, whereas, in my opinion, it is a pleasant and interesting sight to watch the manipulation of the melted metal when it is poured into the molds.

The blacksmith, on the other hand, has at least twice been shown in a pleasant and truthful light—namely by Longfellow in 'The Village Blacksmith' and also in the Armorer's song in the opera 'Robin Hood'.

The first worker in metals of which we have any record is mentioned in the Scriptures, namely Tubal Cain† (B. C. 3875), who taught all artificers in brass and iron, but nothing has come to us by which we can judge of the class of work that he did. We do know, however, that the Phoenicians were the earliest navigators, inventors, and mechanics of those days, more especially in the working of bronze, going as far as what is now Cornwall for tin. This was done in prehistoric times. The Egyptians also had a high and ancient civilization and knew the art of casting statues of men and animals 3000 years before the Christian Era; these works were cast hollow, thus showing a high degree of skill on the part of the founder.

The first definite account of work of this kind is in the description of the building of King Solomon's Temple in the First Book of Kings, Chapter VII; also Second Book of Chronicles, Chapter II, wherein it is set forth that King Solomon sent to Hiram, King of Tyre (the chief city of Phoenicia) for a suitable superintendent to take charge of the skilled workmen gathered together by his father, King David, and the great works in connection with the building of the Temple. Hiram, King of Tyre, sent him another Hiram, who "was a worker in brass and was filled with wisdom and understanding and cunning to work all works in brass." The size and character of certain large castings are shown clearly and certainly called for great care and skill in molding and pouring.

Take the two columns in King Solomon's Temple. Their height was 31 ft., diameter 7 ft., and thickness 4 in., which would make the weight about 60 tons. These columns were profusely ornamented, in a manner which in itself called for a high degree of skill on the part of the molder. We read also there was a 'sea' or 'laver' (we would call it a pan today), 17 ft. diam., 8½ ft. deep, and 4 in. thick. These pieces were all cast of brass or rather bronze, because brass was not discovered till long after this period. This pan was supported on 12 brazen oxen and, like the columns, had a great amount of decoration on it. When a youngster I paid little attention to the sizes of these great castings, but some years after, when I knew something about the numerous dangers and difficulties which beset a molder's attempts to make a decent casting, and found by personal experience a few of the thousand ways in which a casting may be lost, I began to think how these great tasks were accomplished. A full and complete account with a close description of those beautiful and valuable castings and sacred vessels, also the story of their destruction, is given in the 52nd Chapter of Jeremiah.

What I believe to be the early method of blowing furnaces or cupolas, I discovered accidentally. This was in my youth in Australia, while tramping through the bush, as the wilderness is called there. I came across an abandoned mine which was being worked again by a company of Chinamen. The Blacksmith work was done by one of their number. He used a pestle for a hammer, and his bellows for blowing the fire was made of leather shaped like a sugar-loaf, with a wooden bottom and an ordinary valve with a handle on top. With two of these, alternately lifting and pressing, he kept a steady blast on his fire through a little pipe from each bellows. The Egyptians had bellows similar to this, but used their feet instead of their hands. Also I recollect reading of an explorer in Africa, who saw a negro cast a steel bell. The description of the bellows was identical with what I had seen in the bush in Australia. The negro blew all his steel down in his cupola, and then let it run into the mold, and, according to the explorer, made a bell with a good tone.

As the Chinese claim to have made no changes in their civilization for two thousand years, it is likely enough that for two thousand years before that, the same kind of bellows was in use, so it can be assumed that Hiram used just such bellows as these for his furnace work. As we are told that he had 80,000 skilled workers in the quarries and elsewhere and 75,000 helpers, it would have been just a holiday for a few thousand to come and work a lot of bellows of this kind when a large piece was cast. The metal must have been melted in several furnaces and gathered in one large tank and tapped directly into the mold.

How he managed to lift such large copes and cores is a mystery to me to this day, but the same methods that were used to lift those immense blocks of stone in the

*Extracts from address delivered at a banquet of the California Foundrymen's Association.

†Genesis IV.

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pyramids and other ancient buildings would certainly suffice for him.

Besides these castings, there was an immense quantity of other intricate and difficult founders' work done at the same time which speaks very highly for the skill of our ancient brethern, especially of that wizard Hiram. Another renowned piece of work was the Colossus of Rhodes, a huge figure 122 ft. high or thereabout, which straddled the mouth of the harbor and was large enough for the ships of that age to pass under it. This was cast in sections. An earthquake shook it down and it was never put up again.

In Nara, Japan, there is a colossal statue of Buddha, 'Dai Butsu'. The casting of this wonderful piece of work was, after eight failures, accomplished in 749 by Takusho, an artist from Korea.

The height of the figure is 55 ft., the face is 15 ft. long, the ears 8 ft., the nose 3 ft., and the grand halo is 80 ft. diam. There is also at the same place a monster bell, cast in 732, 13½ ft. high, 9 ft. diam., weighing 37 tons.

Another large casting of early times is the great bell of Peking, nearly sixty tons in weight; also of a comparatively recent date is the bell of Moscow of 220 tons. This immense casting is cracked. It lay on the ground for over a hundred years before it was raised to its present position. The crack was a double one. The piece that fell out weighs 11 tons. This is the doorway and the bell is now used for a chapel. It is 20 ft. diam., 19 ft. 6 in. high, and 24 in. thick in the chime. This bell was cast by Boris Godonov, the bell now in use being the third effort, and was raised to its present position by Nicholas I, in 1835. There is also another large Russian bell weighing 61 tons. Godonov is entitled to a deal of credit for handling such a huge quantity of metal, for Russia at that time did not appear to have had many skilled mechanics like those gathered at the building of King Solomon's Temple. The crack, no doubt, was caused by having too hard a core, a couple of cart-loads of sand bricks would have saved it.

In the Tower of London I noticed some Hindoo bronze cannon, spoils of war, with raised filigree work all over them, showing considerable skill on the part of those oriental molders. There is also a large cannon 17⅔ ft. long and weighing 19½ tons, cast of bronze and profusely and beautifully decorated with raised filigree work.

To come to our own times and to cast-iron, the earliest record for casting the same was in England in the manufacture of pipe about 1610, also the casting of cannon weighing 6000 lb. The Germans claim nearly 100 years farther back than that. It is said there is a cast-iron column in Delhi cast 1100 years ago. Very likely cast-iron has been in use much longer than that in China.

While cast-iron has grown to be of much importance in the world, steel has made great inroads into the field ever since Bessemer's invention, which has completely changed the methods of building machinery, ships, and buildings. First came the Bronze Age, then the so-called Iron Age, and now the Steel Age. In ancient times the different metals were in the first instance used as weapons of offense or defense, so even Bessemer was trying to make an improved cannon when he blundered on the making of steel. It is on record that he made one small cannon, but to the best of my belief, made no more, although Sir Joseph Whitworth, Krupp, and others followed up that line with great success. It must, therefore, be admitted that the father of modern steel makers was successful, as all cannon are made of steel at this time. Since Bessemer's invention great progress has been made in the manufacture of both steel and iron and some of the modern plants would find little out of common in making such pieces as have been mentioned in this article. In 1854 Mr. Ireland, the inventor of the centre-blast and the double row of tuyeres for cupolas, poured an anvil block weighing 220 tons, with two cupolas, 60 in. diam. inside, taking from start to finish 10 hours and 45 minutes. This was done at Bolton, Lancashire, and may be considered good work, but it certainly would not do for those ancient castings mentioned above, as only a few minutes could be allowed for pouring even the largest of them.

I would like at this time to say a few words on the low grade of skill shown by the average molder of today, and why so few attain excellence. I think it is not altogether his own fault. Modern requirements call for castings to be duplicated, so a molder gets in a rut, where he is not obliged to think up new methods and finally becomes unfit to cope with any unusual set of conditions.

The jar machine and squeezer reduce the amount of knowledge required by a molder, and where such tools are used a low grade of skill is sufficient. Such workers never really become molders. The inference seems to be that as the years roll along the good molder becomes scarcer and more valuable. Another factor in the case is the limitation of work by which the naturally fast and clever mechanic is kept back to the pace of the inferior one, thus tending to kill the individuality of the better workmen. Another condition tending to keep the average molder from advancing is that because of the high minimum wage, he is not likely to draw better pay in proportion to increased ability. There is also a tendency in many shops, when an apprentice gets a little useful, to keep him at the same class of work, so when he serves his time, he is lacking in experience, thus adding to the list of incompetents.

It is in shops where a good class of work is done, and a pattern is not used too frequently that the highest skill will be found. It is there that the real foundryman will survive and transmit his knowledge and skill to others, for in casting perhaps only one piece much economy and makeshift will be employed. This calls for the best efforts of the man engaged in order to make good, whereas, on the other hand, for manufacturing on a large scale, there is no limit to the rigs and appliances, provided this will reduce the cost of production. The skill of the molder cuts a smaller figure than with a similar job in a shop with less facilities.

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Wages and Working Conditions in the East and the West

By ANDREW KERR

During the past two months I have had an opportunity to visit manufacturing centres throughout the Middle West and the East, and incidentally to look into the labor situation and general conditions. It may be of interest to the trade to learn that in so far as my observation carries me, the tendency on the Pacific Coast is to create a condition, which, if carried out to a final conclusion, will have the effect of reducing our plants to mere repair-shops, employing but a few hands in comparison to the numbers now working at their respective tasks.

The much discussed and advocated eight-dollar minimum for skilled mechanics and lesser sums for the semi-skilled and unskilled help, is largely propaganda originating and ending right here on the Pacific Coast, as in none of the sections that I visited was there a minimum scale of wages in effect that approached such figures, nor, in so far as I could learn, was any such contemplated.

By way of illustration I enumerate herewith minimum-wage scales prevailing in some of the localities I visited, including both the Atlantic Seaboard and the Middle West sections.

Minimum-Wage Scale

	Rate per day
Plainfield, N. J.	
Molders	$5.80
Laborers	3.04
Pattern-makers (wood)	3.60
Core-makers	5.80
Philadelphia, Pa.	
Molders	5.75
Core-makers	5.75
Laborers	3.50
Pittsburgh, Pa.	
Molders	6.00
Core-makers	6.00
Laborers	3.50
Cleveland, Ohio	
Molders	6.00
Core-makers	6.00
Laborers	4.00
St. Louis, Mo.	
Molders	6.00
Core-makers	6.00
Laborers	3.25
Melters	3.50
Belleville, Ill.	
Molders	5.75
Core-makers	5.75
Melters	5.00
Laborers	3.60
Quincy, Ill.	
Molders	5.75
Core-makers	5.75
Melters	4.00
Laborers	3.00
Pattern-makers (wood)	4.80

I am not advocating a low scale of wages for the Pacific Coast district, but I do contend that if our industries are to survive the stress of competition that may well be expected from the old-established and well-entrenched manufacturer beyond our borders, we must expect and are deserving of the protection to which our local manufacturers are justly entitled if both employer and employee wish to see them survive, for, just as certain as the night follows the day, unless we enjoy wage schedules and shop conditions as favorable as those obtaining elsewhere, Eastern competition will automatically regulate the Pacific Coast institution out of business.

I also took particular pains to investigate living conditions and can say without reservation that we of the Pacific Coast do not appreciate how fortunate we are in this respect, as living is considerably higher in most of the localities I visited than anywhere along the coast.

Touching but lightly on the question of the so-called forty-four week, I would say that the movement has not gained impetus. While in some sections a half-holiday on Saturday is being allowed during the months of June, July, and August, on the other hand, this has not become general throughout the entire year, as some of us have been led to believe.

In the various cities along the Pacific Coast from Seattle south, I found trade with machine-shops and foundries was exceedingly dull with but little work in sight.

Unquestionably the constant agitation among the different elements here is having a most disquieting effect on the minds of the prospective purchaser, and the sooner we reach a point where labor conditions are stabilized for a definite period so that concerns can figure future costs and requirements with a reasonable certainty, the better it will be for all parties interested.

Trade Notes

Kingy writes that he hopes to command more attention at future meetings. He has grown a mustache while on his vacation.

Do you remember the old days when a man would come up to you and say "What will I do next," and you would compliment him on his efforts. Those were pleasant days. Nowadays you figure what he will make to fill in the afternoon, but the whistle usually blows before he's finished the other job.

Davie intends to match coins hereafter. He figures that John has a set of loaded dice up his sleeve.

Note: Since the above was written, John informs us that Dave's coin-matching scheme while it sounds very good in theory, has as yet not worked out in practice. We are told that even the coins refuse to flop right and that therefore Dave had to foot the bill for three dinners the other day. If Dave is looking for a tip we would suggest that he resort to wooden money or rubber nickels, or possibly a double-headed coin, anything to defeat John, the invincible.

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Book of a Thousand Excuses for All Persons Connected With the Foundry Trade

CHAPTER III

Pig-Iron Dealer's Excuses for Non-Delivery of Pig-Iron on Time

The pig-iron dealer's excuses vary with the times. Many years ago when all of the pig-iron used on the Coast was shipped from Europe as ballast in sailing vessels and it was necessary for a foundryman to carry a ten years' supply in order to ensure against running short. The favorite excuse worked about like this. Mr. Foundryman, finding his stock running down, say only a three years' supply on hand, would call on Mr. Dealer and demand an explanation of why Mr. D. had not delivered pig as agreed and which should have been delivered as per contract some four years ago. Mr. Dealer solemnly explains that he is indeed very sorry. The ship left Europe on time, but has not been spoken since. Possibly lost rounding the Horn. He promises to start another ship with additional tonnage within six months, and Mr. Foundryman must go away not one bit satisfied but what can he do? Some bright morning Mr. F. wakes up and finds six ships in the harbor, each ship with a ten years' supply of pig-iron for him. All of the lost ships are found and Mr. F. is nailed for life.

A little later, pig was shipped from the Orient in steamers, and Mr. F. was glibly informed that now his troubles were over. All that was necessary for him to do was to figure out just how much pig he needed per week, and it would be shipped just as he wanted it, as there would be a steamer every two weeks. The first two shipments came through on time, and Mr. F. commenced to feel as though he were on the map. Shipment No. 3 did not show up and the excuse was that a typhoon had put the ship out of commission. Shipment No. 4 failed to put in an appearance. Mr. F. was informed that the Chinks had the cholera, and the furnace was shut down for ten days. From now on excuses were about the only commodity delivered, except possibly a few stray lots of pig that was rejected as unfit for use by our good friends in the Orient. If it were not for the fact that most of the foundrymen were in a position to produce plenty of scrap in their own shops the casting business would have been put out of commission.

About this time lower rail-rates made it possible to bring pig from the East. A new set of excuses was necessary, such as

Car shortage.
Road blocked by snow.
Train went over the bridge.
Car lost en route.
Train collision, pig lost.
Wheel came off car.
Hot box, car stalled.

These new rail excuses would fill a book and Mr. Dealer was in his glory.

The War came, changing conditions once more. Mr. Dealer showed himself equal to the emergency. When Uncle Sam sat down on the pig-iron pile, and said "This is all mine for making bullets," Mr. Dealer became very patriotic and offered his services at one dollar per year. Our Uncle told him to beat it, as he could take care of the pig-iron pile himself. Mr. D. decided to work without the dollar. He offered Mr. Foundryman re-sale pig-iron, which when it did not show up, could be simply excused by saying that Uncle had grabbed it.

Our Mr. Foundryman received only such pig as was entirely unfit for foundry use. By doping it with some good scrap Mr. F. managed to get by. It was a tough game and Mr. F. hopes that it will never happen again. Peace has been declared, and a new set of excuses is now in the making. These new concoctions will be reviewed at a later date. Our next chapter "Draymen's Excuses for Non-Delivery of Castings on Time," will be instructive as all foundrymen have wondered what happened to the castings en route between the foundry and machine-shop. Draymen, send in your excuses.

C. J. P. H.

The Labor Situation

By An Occasional Contributor

During the long and turbulent history of the growth of labor unions there probably never existed a situation to compare with the present one.

All the admitted leaders and champions of the cause are at an apparent loss to advise in the present situation.

They have steadily striven for years along one line, namely, to improve the workmen's condition, by aiming at higher wages and shorter hours, and now that the results of this persistent policy have like a boomerang been returned in the shape of the higher cost of living, falling like the rain on the just and the unjust, we find organized labor the loudest and bitterest complainant, forgetful or unwilling to acknowledge that its past endeavors have played a large part in bringing about the present situation, which was an inevitable result of such efforts. During normal times union men did often acquire better conditions for themselves than obtained among fellow workmen outside the unions, but their advantage has proved to be only temporary and, from the present outlook, living costs will hereafter follow closely any variation in wage-scales.

Labor persists in trying to gain personal advantage through collective action. The two do not go together, and labor must permit a freer development of individual effort if any permanent benefits are to be attained. Unfortunately labor's only solution for the present situation is further demands.

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Trade Notes

A meeting of the foundrymen was held at the Palace Hotel where matters of great importance were discussed; such as, shall our meetings be held in the day time or evening; it was the non-sense of the meeting that no decision was reached.

A request on a piece of paper for fifty dollars or less is a bill, but the same thing for any thing over that amount is an invoice.

Our reporter sends in word that the Yosemite valley is likely to have a foundry in the near future, specializing on squirrel-traps; he got the tip from seeing Charley Hoehn spend a week there.

Consider ye foundryman, he hiketh and rusheth around for orders and taketh ye job at a price below freezing point to keep his shop moving and his gang together, and then he getteth ye tip that his men want more money and he kicketh himself on ye back porch for being a mutte and sayeth unto himself, it is better to watchfully wait for the dawn of a new day than it is to take jobs at a low price so that the shop will look busy enough to run up the wages.

Macaulay is building a ranch or a farm up under the shadow of 'Mount Diabolo'. He says it's a great life if you don't weaken, and he likes to play with the chickens and ducks 'n' everything, but he misses the aroma of burnt core-flour.

The Gethsemane Scrap Iron Co. has been organized and will carry a full line of all kinds of useless scrap.

Rumor has it that a new foundry was started down on the flat, consisting of a cupola, sand pile, eight flasks, and four cans of smooth-on; but it takes three salesmen to keep the orders coming in. We welcome them to the fold, because any fellow who can stand the losses brought in by three salesmen is just three times as welcome as the fellow who can afford only one.

Some foundries are so skilful in placing blowholes that they can save the cost of cores.

Will the time ever come when the machine-shop can't blame delays upon the foundry?

The foundry business is the easiest one in the world, everything is all arranged for the foundryman by some one else. The customer tells him what price to make, the scrap-iron and pig-iron dealers tell him what to pay for iron, the men tell him what to pay for wages. All he has to do is to jiggle these items, and then sign another note at the bank every month.

The fellow that gets a bite and never pulls in his line is like the fellow that knows what his costs are but never uses figures.

Jack Mears is back from his vacation. Look out, he's so full of pep he'll sell you some pig-iron whether you want it or not.

The shipbuilders are trying to work out a uniform agreement up and down the Coast, which will be a nice job and ought to be fully as easy as working out the League of Nations.

They tried out a new midget gasoline-tractor at the Pacific the other day; it was a wonder; it went down town for the order, brought out the pattern, rolled down a sand bed, went out for the flask, dumped in the sand, filled the cupola and watched the pouring, then cleaned and delivered the casting, washed its hands and made out the bill, and then went around the corner and stuck out its tongue at the Enterprise.

Billy Kingwell is off on a vacation somewhere and his brother Charlie is holding down the job.

The Foundrymen's convention will be held East sometime this fall. If it comes in between strikes let's a few of us go.

Charles Kellie is going to Packard around up North, for a few weeks.

How would it do to have a 'casting day' and parade up Market street with a brass band and with banners and badges reading:

"Join the eight-cents club."

"A Foundryman and his money are soon parted."

"A pig in time saves nine."

"Oh, be joyful."

"The glad hand gathereth orders."

"A soft answer turneth away the pig-iron dealer."

"He that sorrows and is heavy laden had better leave the foundry business alone."

"A blowhole in the right place is better than a core in the wrong place."

"Cherish the machine-shop. It may have an order some day."

"Repent and make it ten cents a pound."

"Down with the flywheel-less gas-engine."

"Respect the sewer-fitting expert, for it keeps him away from a good market."

A fuse blew out on our switchboard. The flask-maker said that he was subject to a fine if he butted in. Had to get an electrician.

The new speed-law allows only 35 miles. Charlie Kellie take notice.

The other afternoon, while a party of ladies was visiting the foundry during blast-time, one of those annoying sparks of hot iron struck a molder in the region of his Adam's apple and sort of found its way inside his shirt. He turned rather quickly and began to wiggle when another shot struck him in the back. The wiggle sort of changed to an oscillating movement, starting from the shoulders and ending at the feet with a quiver. To my surprise one of the ladies who had not observed the sparks began to applaud and asked me if he was doing the 'shimmey' for the benefit of the visitors, or was he practising for a contest.

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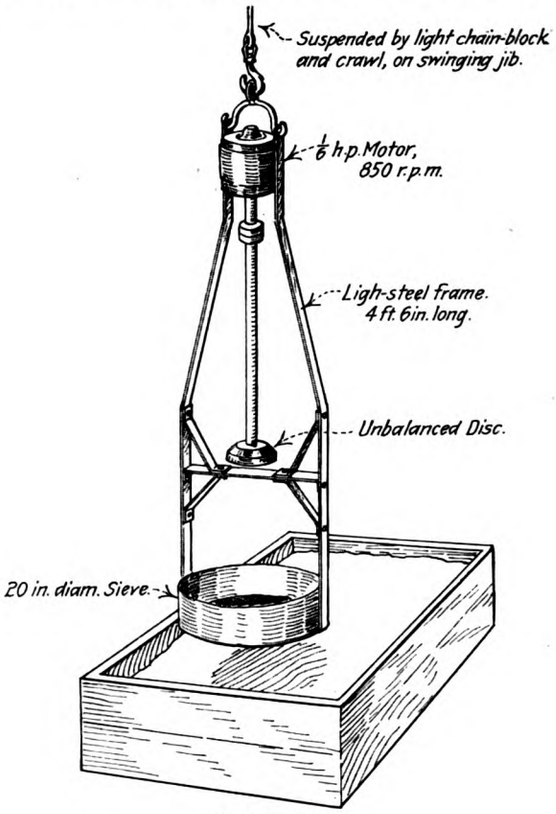
INDUSTRIAL EQUIPMENT

A USEFUL RIDDLE FOR THE FOUNDRY

By Oliver E. Jager

The riddle herein described is known as Combs Gyratory Riddle (patented), made by the Great Western Manufacturing Co. of Leavenworth, Kansas. As shown in the sketch, it is suspended by a light chain-block from a crawl on a



Foundry Riddle

swinging jib, which is usually set in position over the molding machine. A sieve is fastened into the frame with a strap and buckle so it can be readily changed. The frame, B, is made of light steel, and is easily swung around by one hand, so that the sifted sand can be distributed over the flask as desired. On starting the motor a speed of 850 r.p.m. is imparted to the shaft carrying the disk, which is weighted at one side, thus producing a rapid succession of light shocks on the sieve. The sifting is so rapid that sand will pass through as fast as one man can shovel into the sieve. This riddle is particularly adapted for rapid work with molding machines.

THERMIT REPAIR OF A MANIPULATOR SIDE-BEAM

An instance of the use of thermit welding for repairing heavy steel sections of all kinds in the steel-mills is shown in the accompanying photograph of a repair recently made of a cast-steel manipulator side-beam at the plant of the Brier Hill Steel Co., Youngstown, Ohio. Thermit is a mixture of aluminum and iron oxide. This mixture is ignited by means of a special powder. The reaction produces superheated liquid steel and slag (aluminum oxide), at a temperature of approximately 5000°F. This thermit steel is hot enough to melt and dissolve the metal with which it comes in contact and mixes with it to form a solid homogeneous mass when cool. In making the repair shown, the gaps between the parts to be united were filled with yellow wax to form a pattern and then surrounded by a mold. Pre-heater torches were then directed into the mold, serving the triple purpose of drying the mold, burning the wax away, and heating the broken sections to a bright red heat preparatory to welding. The thermit steel was then poured into the mold. The three welds were made simultaneously. A total of 1200 lb. of thermit was used in making the welds. The illustration shows the excess metal in gates and risers before being removed. The function of a riser is to hold a

Beam as Repaired and Before Risers Were Removed

supply of liquid steel, which will feed into the weld during shrinkage and thus fill any pipes that may form in the weld. It also allows any foreign material to be washed out of the weld into the riser.

ELECTRO-GALVANIZING PLANT AT WEST BERKELEY

The California Corrugated Culvert Co. has completed an electro-galvanizing plant at its West Berkeley factory. While primarily intended for the company's own needs in electro-galvanizing rods, bolts, and sheet-metal parts, this plant is also available for custom galvanizing work. Until the construction of this plant most electro-galvanizing work requiring a superior type of finish has been done in the East. As a result, many important contracts for metal parts, machine-tool products, castings, and stampings have gone to Eastern factories accessible to electro-galvanizing plants. The articles were then shipped West at the high freight-rates on finished products, and this added to the cost of the article on the Pacific Coast.

The Meaker Process type of plant has been installed. It is a recently perfected method, using a self-sustaining chemical solution, which eliminates inexact results caused by the use of undependable rapidly deteriorating salt solutions. Pure zinc is deposited on the objects being coated in a fine, even, ductile coat of great density. By the use of this process, the necessity for cleaning the zinc anodes, or of adding additional zinc, or toning salts is eliminated.

The plant is designed to take rods and bars up to 25 ft. long. It is especially efficient in galvanizing such articles as machine-screw products, nuts and bolts, where measurements, threads, and contour must remain without material change, and for steel and iron, requiring a surface of fine texture and smoothness for the application of enamel, paint, or other coating.

Charles F. Ruggles, a Michigan lumberman, has bought 100,000 acres of timber land, mainly in Calaveras county and will log the property. A mill will be built either at Stockton or at Valley Springs.

The Goodyear Tire & Rubber Co. has commenced work on its new plant at Los Angeles. The total estimated cost is $6,000,000.

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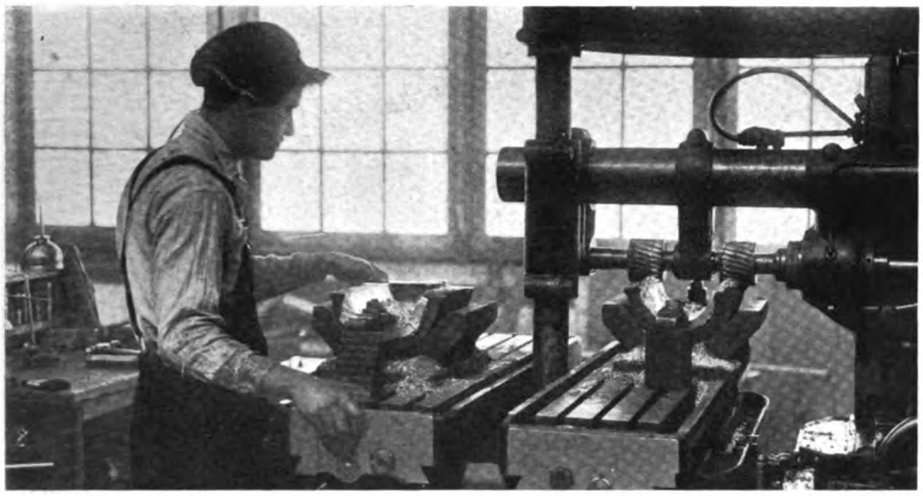
MILLING BEARING-BOXES

The accompanying photograph was taken in the shop of the Skandia Pacific Oil Engine Co. and shows the milling operation on crankshaft-bearing half-boxes on a Potter & Johnston machine. The pieces are of cast-iron and are held in fixtures and secured by means of heavy clamps. As shown in the photograph two cutters are used, finishing the two milled surfaces. While these are being machined, the operator is unloading, cleaning, and reloading the fixture on the other table. When the machining operation is completed, the operator pushes down on the foot-lever at the front of the machine. This in turn withdraws the lockbolt and engages the clutch, which revolves the turret. The table just loaded assumes the working position and the operator repeats his work. In this way the piece does not travel back under the cutters and therefore shows no cutter-marks when it is finished. Only ten seconds is required to revolve and index the table-turret, and this is the only period when the cutters are not cutting metal.



Milling Bearing Boxes

WET AND DRY GRINDING OF TOOLS

The fact that points of tools are blued while being ground indicates that the metal is being heated because the wheel on which the tool is ground is too hard. As a matter of safety, it is better to use a wet tool-grinder, when it can be done conveniently. However, it is not necessary to use water to get satisfactory results, if the wheel used is of exactly the right grain and grade, the grade indicating the hardness of the wheel.

A wet tool-grinder might be desirable for the reason that it may be difficult, without the services of an expert on grinding-wheels, to secure exactly the right wheel for the tools to be ground. Another factor that enters into the results obtained is the manner of the application of the tools to the wheel. One person may get an entirely different result from another, because of applying the work with more or less pressure. Excessive pressure of the tool on the wheel will cause it to heat and thereby draw the temper. This may be prevented by the application of water. When using a wheel without water excessive speed will have a tendency to heat the metal.

AUTOMATIC VALVE IN OIL-LINE

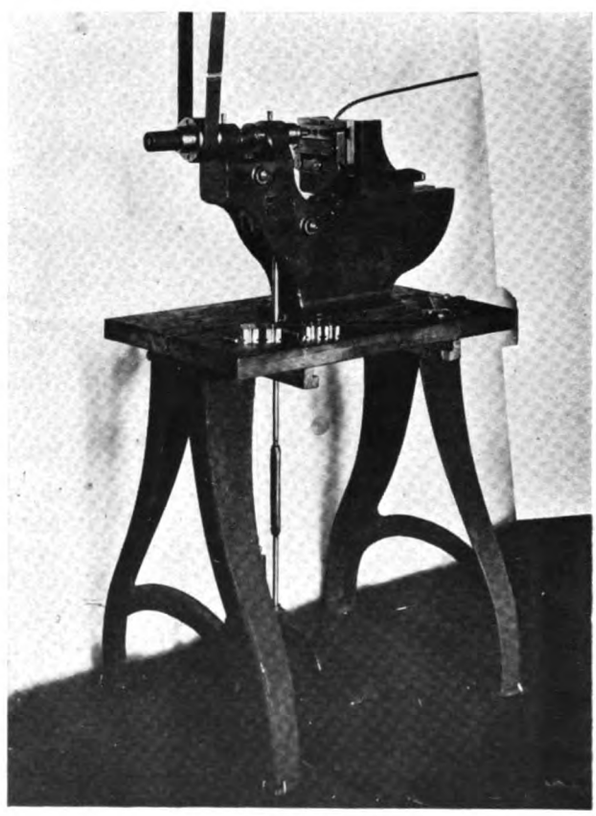
To relieve the pressure caused by explosions of gas flare-backs in an oil refinery condenser, a simple automatic valve, of the kind commonly used for automatic drainage gates on reclamation and drainage districts, has been employed. The device has been in use for more than a year in the processes of refining asphalt-oils and has been satisfactory. The few times when flare-backs have occurred have served to test it and demonstrate its value as a safety-valve arrangement.

The valve is used with 180 ft. of 36-in. corrugated Armco iron pipe, which comes from above the stills, makes a right-angle turn around a corner of the plant, and leads into a collecting-tank at the lower end, from which a 50-ft. Armco iron pipe-stack rises. The 36-in. pipe is on a slight incline and the automatic valves have been placed in a horizontal position in manholes, 12 in. diam. on top of this pipe-line.

The valve is of cast-iron, closing on a cast-iron seat, which is carefully machined to ensure sealing of the gate. It is hung on a pair of steel links, attached to steel pins, cast integral with the valve on opposite sides. While loosely fitted, all the connections are sufficiently close to prevent the valve from turning over, or from getting stuck in an open position. A slight back-pressure will cause it to lift from the seat, relieving the danger of an explosion almost instantly, after which it drops back on its seat, sealing the condenser again.

SPINNING MACHINE FOR TUBING

The Grant Mfg. & Machine Co., Bridgeport, Conn., has placed on the market a new spinning machine intended principally for flanging the ends of brass and copper tubing.



Flanging Machine for Tubing

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The tubing is held in position by a hand-clamping arrangement attached to the table or knee of the machine. The gripping-jaws can be removed and others inserted to accommodate different sizes of tubing. The machine will flange tubing up to 1 in. diam. at the rate of one flange per second. The machine is mounted upon a bench in a horizontal position, which permits of flanging any desired length of pipe. The operation is controlled by a foot-pedal. Machines are arranged for operation by either belt or motor-drive.

TOOL-HOLDER FOR STELLITE TOOLS

Some difficulties were experienced with stellite breaking in the ordinary tool-holders in the machine-shop of the Moore Shipbuilding Co. As this metal is superior to tool-steel for some work, W. H. McKenzie, general foreman, designed the tool-holder shown in the illustration. The stellite is slipped into the dovetailed recess and then forged to a

Tool-Holder

tight fit. The strain is then taken up by the tool-holder and the stellite is required to do the cutting only. This tool-holder is used satisfactorily in both lathe and boring-mills.

Stellite is an interesting alloy composed principally of tungsten, cobalt, and chromium manufactured by the Haynes Stellite Co., Kokomo, Indiana. The cobalt is used as a binder or matrix, the chromium and tungsten as cutting particles. The chromium and tungsten have a higher melting-point than cobalt, and cobalt is of such a nature that the hotter it gets, the tougher it becomes. This makes it advantageous when using stellite tools to heat the tool to reduce the chances of crumbling. It is a cast metal and is unaffected by heat up to about 2100°F., at which point it begins to crumble slightly, but, if allowed to cool below this point, it is as hard as it was originally. Stellite is not a steel and cannot be forged, heat-treated, or annealed. To get the best results, faster cutting-speeds should be used than with high-speed steel. It is not the length of time between grindings that should be taken into consideration in the comparison of two tools. It is the removal of metal and consequent production that counts.

TRADE NOTES

The California State Rice Milling Co. will build additions to its mill a Sacramento.

A bond issue of $400,000 for the construction of highways has been voted in Modoc county.

The Union Construction Co. launched its fourth ship for the Emergency Fleet Corporation, the 'Havilah', on July 31.

The Moreland Truck Co. will spend $500,000 on increasing the capacity of its plant at Burbank, near Los Angeles.

The Pacific Gas & Electric Co. will spend $100,000 on extensions of its gas distribution system at Fresno.

C. S. Coler has been appointed manager of the educational department of the **Westinghouse Electric & Manufacturing Company.**

The Philippine Commercial Agency has opened offices in the Merchants Exchange Bdg., San Francisco, in charge of James J. Rafferty. This is a Government institution intended to promote trade between the United States and the Philippines.

Plans are being prepared for a $100,000 education building to be constructed on the University of Nevada campus at Reno.

The Capital Van & Storage Co. will construct a reinforced concrete warehouse at Sacramento. The estimated cost is $125,000.

Contract for dredging in Kahului harbor, Hawaii, has been awarded to the **Hawaiian Dredging Co.**, of Honolulu, for $95,921.

Contract for dredging the Columbia River slough at Portland has been awarded to the **Pacific Bridge Co.**, of Portland, for $309,000.

The Lindsay Hotel Co. has been incorporated to construct a tile-and-stucco hotel-building at Lindsay, California. The estimated cost is $200,000.

The Ojai Improvement Co. is constructing a hollow-tile and concrete hotel-building at Ojai, Ventura county. The estimated cost is $125,000.

The Foundation Co., of Portland, will construct a pier and reinforced concrete warehouse for the Port of Astoria. The contract price is $815,000.

Contract for construction of the snagboat 'Bear' has been awarded by the U. S. Engineer Office to **Schultz & Schultz**, of San Francisco, for $117,000.

Contract for paving the State highway through Eureka has been awarded by the city council to the **Worswick Construction Co.**, of Vallejo, for $309,597.

Contract for the construction of four 6000-ton steel steamships for a Scandinavian syndicate has been awarded to the **Albina Engine & Machine Works**, of Portland.

The U. S. Shipping Board has reinstated contracts for the construction of five 12,000-ton steel ships to be built by the **Los Angeles Shipbuilding & Dry Dock Company.**

The American Pulley Co., of Philadelphia, has decided to extend its line of 5-in. face pulleys above 24 in. diam. to include all standard diameters between 25 and 42 inches.

The South San Joaquin Irrigation District has decided to issue bonds for $500,000 for improvement of its system, the principal work being the lining of the ditches with concrete.

A bond issue of $807,000, $521,000 of which is to be spent for bridges, $200,000 for a new court-house, and the remainder for highways, has been voted in Tehama county.

The Wilson & Willard Manufacturing Co. has completed its new plant at 2301 East Vernon avenue, Los Angeles. The buildings are of brick and reinforced concrete, and cost in all $150,000.

Contract for erecting 450-ft. steel radio towers for the Federal government at South San Francisco has been awarded to the **Pittsburgh-Des Moines Steel Co.** at 11.88c. for steel in place.

Plans are being prepared for the new Alameda County hospital building. The total estimated cost is $2,500,000. Bids for the first unit, which will cost $750,000, will be received in November.

The Los Angeles Harbor Commission has awarded a contract for furnishing a cotton-compress to the **Southwark Foundry & Machine Co.**, of Philadelphia. The complete equipment will cost about $76,000.

John R. Gray and Harry W. Frister have organized the **Oriental Supply Syndicate**, with offices at 688 Howard street, San Francisco. The company will handle mill supplies and machinery, particularly for grain and rice mills.

The Southern Pacific Co. will construct a branch railroad extending from a point near Knights Landing through the

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Sutter basin, 18 miles. Work will be rushed so as to have the line completed in time to move this season's crops.

Contract for the interior finishing for the Temple of Justice at the Washington State capital at Olympia has been awarded to **Pratt & Watson,** of Tacoma, for $283,267. This is nearly twice the original estimate prepared in 1913.

The directors of the Modesto and Turlock irrigation districts have adopted plans for the construction of a concrete dam at the Don Pedro reservoir-site. A bond issue of $3,750,000 will soon be submitted to the voters of the two districts.

A receiver has been appointed for the **Columbia Engineering Works,** of Portland. The company owned a wooden-ship yard at Linnton, Oregon. Failure to obtain contracts for ships after the armistice is given as the cause of the company's difficulties.

The Combustion Engineering Corporation, 11 Broadway, New York, has issued a 12-page bulletin describing a novel and efficient tube-scraping device recently developed by the corporation. Copies of the bulletin may be obtained by application to the corporation.

The Pacific Gas & Electric Co. has acquired the property of the **Northern California Power Co.,** including 525 miles of high-tension transmission lines, power-plants with a capacity of 50,000 hp., and an undeveloped power-site on Pit river, where 90,000 hp. can be generated.

E. J. Hall, first vice-president of the Hall-Scott Motor Car Co., has been awarded the distinguished service medal for

Colonel E. J. Hall

his services in connection with the design of the Liberty motor and as chief of the technical division of the air service.

The Mervy-Elwell Co., of Oakland, is constructing a 250-ft. extension to the fitting-out wharf of the **Pacific Coast Shipbuilding Co.** at Bay Point. The addition will bring the total length of the wharf to 700 ft., and will materially assist the work of completing the ships built at the yard.

The marine ways of the **Moore Shipbuilding Co.** has been extended and enlarged to take vessels of 4000 tons. Two additional marine ways are now under construction, each capable of handling vessels of 6000 tons, and a floating dry-dock, with a capacity of 12,000 tons will also be completed during the next few months.

The Hall Scott Motor Car Co., of Berkeley, has just received two carloads of machine tools which it has purchased from the Federal government. The lot includes two 24-in. Steinle turret-lathes, one No. 4 Cincinnati vertical milling machine, two No. 315 Baker drill-presses, and three 34 spindle No. 3 Bausch multiple drills.

The Van Neil Brass Foundry, 2319 Clement street, Alameda, will be ready to pour its first heat about August 20. The building is 50 by 100 ft. long, and is equipped with a 42-in. Schwartz furnace, 5-ton crane, and other modern appliances. Mr. Van Neil has had 15 years experience in the brass-foundry business. The equipment was furnished by Ditty Bros., Inc., San Francisco.

Smith-Booth-Usher Co. has established offices in the Rialto Bdg., San Francisco, in charge of H. A. Olds. The company also has offices at Los Angeles and Taft. Among the lines handled by the company are the Lakewood Engineering Co., Bessemer Gas Engine Co., Foos Gas Engine Co., Clyde Iron Works, Cincinnati Iron & Steel Co., Barber-Greene Co., and Van Norman Machine Tool Company.

Francis B. Longley, Colonel, Engineer Corps, U. S. A., has been decorated with the Distinguished Service Medal by Major General Biddle, Commander-in-Chief of the American forces in England. Colonel Longley served his time as a machinist with the Risdon Iron Works, becoming successively shop superintendent of the mining branch of the Union Iron Works, then with the General Petroleum Co. in construction work on their pipe-line, and later with Sanderson & Porter in San Francisco. He entered the service as Major of Engineers early in 1917, and was assigned to duty as engineer officer in the San Diego flying field.

The Merchants & Manufacturers Exchange of New York, which is taking over the Grand Central Palace at New York for the purpose of turning it into a trade clearing-house, announces that one floor of the building will be devoted to an International Material-Handling Machinery and Factory-Appliance Exchange. This will be one of the eight permanent industrial expositions that will fill eight floors of the building. The remaining four floors will be used for short-term expositions of various kinds. **C. R. Ringenberg,** 405 Lexington avenue, New York, is manager for Material-Handling Machinery and Factory-Appliance Exchange.

Where noiseless or nearly noiseless gear-action is desired, rawhide has been the principal material used for a great many years. Upon coming into contact with oil or water, however, rawhide and other non-metallic substances swell and spread, and the efficiency and pulling power is naturally greatly lessened and the life of the gear shortened. To offset this in part, metal flanges are usually riveted on the sides, mostly of brass for small gears and cast-iron for the larger sizes. Even this method did not overcome the trouble satisfactorily, and it remained for the Westinghouse Electric Co. to produce a material, which has been named Bakelite Micarta-D, and which has all the qualities of a metal gear and yet gives smooth-running, almost noiseless action. The **Pacific Gear & Tool Works** are the licensed manufacturers of gears from this material, and their experience has proved Bakelite Micarta-D to be the material needed to fill a long-felt want. The structural and wearing qualities make it suitable for almost any purpose where gears are used. Being self-supporting, it requires neither bushings nor flanges, and quite frequently it can be substituted for untreated steel, cast-iron, or bronze. Bakelite Micarta-D is not affected by oil or water, and will not warp, shrink, or swell. Its resiliency makes it efficient where gears are subjected to severe shock

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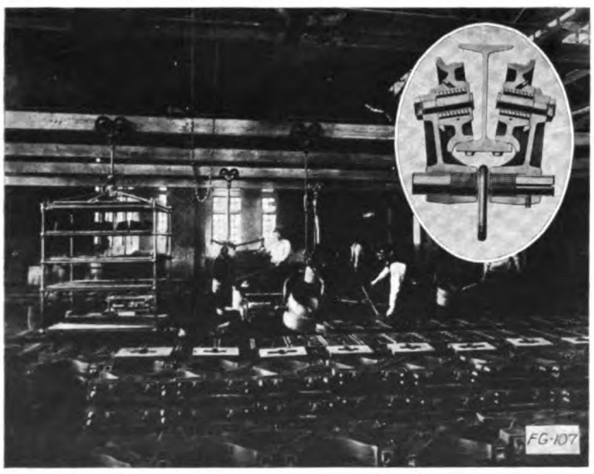
or heavy pressure, as in heavy presses, punches, and similar machinery.

A labor-saving device that is in successful use in many Eastern foundries is the Auto Sand-cutter manufactured by the **Sand Mixing Machine Co.**, Cleveland, Ohio. The machine takes the place of ten men cutting by hand. Its chief value, however, is its effect upon production. Machine

Sand-Mixer

tempered sand rams easier, vents better, gives smoother castings and less scrap, eliminating losses due to wet spots, cracked mold-furnaces, drops, etc. The sand is of the same consistency every day. Relieved of sand-cutting drudgery, the men have all their time and energy for molding work. The machine is built in both the traction type as shown in the illustration, and the crane type. It can be either purchased or rented. The illustration shows the machine in the foundry of the **Sharples Separator Co.**, West Chester, Pa. The operator has cut the large heap of sand shown and then piled it to the position it occupies by running the machine over the cut pile several times. Each time the blades touch the sand, they toss it backward several feet.

The illustration shows a typical installation of an overhead-track system in a foundry. This is at the plant of the King Sewing Machine Co. at Buffalo, New York. The system



Overhead-Track System

is used for pouring as shown, and also for bringing in sand and other bulk material. The trolleys are manufactured by the **Curtis Pneumatic Machinery Co.** The I-beam trolleys are fitted with Hyatt flexible roller-bearings. These trolleys are made in eight different capacities, either geared or plain, and because of the efficient roller-bearings, as well as the lightness and general design of the trolleys themselves, are easily moved. The wheels operate at right angles to the flange of the beam. This produces considerably less friction than when the wheels are cone-shaped and operate parallel to the web. The wheels are specially hardened; the treads are machined; the side-frames are of cast-steel and so constructed that the load is always equally distributed on four wheels. The through-pin is threaded right and left hand, so that the frames can be spread to fit many different widths of beam, and also to make it easy to put the trolley on the beam or take it down, because it is necessary only to spread the frame on the threads until the frames are far enough apart to slip easily over the flange of the beam.

Obituary

F. W. Krogh, founder and president of the Krogh Pump & Machinery Co., died in San Francisco, July 7. He was born in Denmark in 1841 and came to the United States in the early 'seventies. On arriving in San Francisco a year or so later, he established a small windmill shop on the corner of Market and Beale streets. This business grew until in 1898 he purchased the San Francisco Tool Co. and consolidated the two concerns under the name of the Krogh Pump & Machinery Co., continuing in active charge of this enterprise until his death.

Market Review

Throughout the country the iron and steel industry is getting itself readjusted to a peace basis. The production of pig-iron for June, for the first time in several months, showed an increase over the previous month, and as a number of furnaces were blown in during June and July, there is every reason to expect that the July figures will show an even larger increase. Threats of a strike to unionize the industry are impelling furnacemen and millmen to increase production even to the point of adding to stock to act as a reserve in case the strike comes. Prices in general are unchanged except that there are occasional reports of slight advances on some finished products. No one is waiting for lower prices, in fact the opposite would not come as a surprise. Close students of the market predict a slight advance in the price of pig-iron before long.

The present building activity has brought with it a good local market for structural steel, reinforcing bars, and similar material. The demand for pig-iron and coke reflects the dullness in the foundry trade. One local foundry has bought neither pig nor coke since the armistice, having such a liberal supply then that it has proved sufficient for the reduced output of the past few months. If the shipbuilding situation becomes clarified, it is expected that both the foundry trade and other lines mainly dependent on ship work will improve.

The local scrap market is unchanged, with prices around $37.50 per net ton for cast-iron scrap, and $18 per gross ton for steel scrap.

The market for all non-ferrous metals is strong with prices advancing. Ruling quotations July 31 were:

Electrolytic copper	23.75
Casting copper	23.25
No. 1 red ingot brass	21.00
No. 1 yellow ingot brass	16.00
Electrolytic zinc	9.75
Prime Western zinc	9.00
Pig lead	6.25
Antimony	9.00

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